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A

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A

TREATISE ON RUPTURES.

BY

JONATHAN F. C. H. MACREADY, F.R.C.S.

SURGEON TO THE GREAT NORTHERN CENTRAL HOSPITAL; TO THE CITY OF LONDON HOSPITAL FOR DISEASES OF THE CHEST, VICTORIA PARK; TO THE CHEYNE HOSPITAL FOR SICK AND INCURABLE CHILDREN; TO THE CITY OF LONDON TRUSS SOCIETY; AND SURGEON IN LONDON TO THE MERCHANT TAYLORS' COMPANY'S CONVALESCENT HOMES AT BOGNOR.

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TO

My Former Colleague,

JOHN ABERNETHY KINGDON, F.R.C.S.,

AND

My Colleague,

JOHN LANGTON, F.R.C.S.,

I Dedicate this Book,

IN TOKEN OF

ADMIRATION FOR THEIR SKILL, BENEVOLENCE, AND WORTH,

AND

OF GRATITUDE FOR MANY ACTS OF FRIENDSHIP.

JONATHAN MACREADY.

PREFACE.

The following treatise is intended to supply the most essential facts concerning Ruptures. Looking to the vast extent of the subject, it is little more than an outline, and is without pretence of being an exhaustive work.

Ruptures present themselves in two principal states, either with the functions of the bowel undisturbed, or with those functions interrupted. The book has therefore been arranged in two parts according to this natural division. It has not, however, been always possible, especially when speaking of the Pathology of Hernia, to prevent things belonging to the second part from appearing in the first.

Almost all the illustrations are reproductions from photographs from nature. Four were very kindly taken by Dr. Vincent Harris; many are the work of Messrs. Sulman & Co. of Holloway Road. Figures 1 and 2 were made from drawings by Mr. Donald Gunn, and I could wish that the book contained more illustrations from the hand of that accomplished artist.

To those who have aided me by counsel or assistance I beg to offer my grateful acknowledgments, especially to Sir William Savory; to my former colleague, Mr. John Abernethy Kingdon, who gave me access to all his papers: to Dr. Dakin

Dr. Westland, Mr. Henry Knight, and others: to Mr. Pebardy for valuable information, most generously given, on the manufacture of trusses. But above all others, my warmest thanks are due to Dr. Robert Burnet and to the late Dr. James Anderson, whose untimely death obliges me to render this slight tribute to his memory.

JONATHAN MACREADY.

London, *March* 1803.

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A

TREATISE ON RUPTURES.

PART I.—ON RUPTURES WHEN THE FUNCTION OF THE BOWEL IS UNDISTURBED.

CHAPTER I.

INTRODUCTORY.

When the structures forming the abdominal wall are weakened at any given spot, either by original defect or by adventitious causes, so that they lose their resiliency and are stretched by the intra-abdominal pressure, a **rupture** is produced. A way is opened for the escape of the abdominal contents, and under repeated pressure they protrude, carrying before them the peritoneum and skin together with more or less of the intervening layers of the abdominal wall. Thus a rupture, when fully formed, consists of a sac and of its contents, though in its primitive condition it may be no more than a bulging of the parietes over a limited area.

Distinction between Ordinary and Congenital Ruptures.—In the formation of ordinary ruptures the sac and its contents accompany one another. On the other hand, a sac may be the result of a defect in development, and the contents may enter it at any period after birth. Ruptures such as these have been called **congenital**. The word implies that the infant is born with a rupture, but as the viscera do not enter the pre-formed sac till after the birth of the child, it cannot be used in its literal signification.[1] The term "congenital" is generally applied to the rupture whose sac consists of the tunica vaginalis testis. In this sense it is often used in contradistinction to "acquired."

By **acquired hernia** it is meant that the sac is formed during life. As, however, there are a great number of ruptures of which the contents are in an unobliterated part of the processus vaginalis, and as it is impossible to distinguish these clinically (except in rare instances) from ordinary ruptures, and not always even by dissection, we are seldom able to use correctly the term "acquired."

The terms "Rupture" and "Hernia."—The name "**rupture**" also

is open to objection, because it implies an opinion as to the mode of formation of the disease which has long since been proved to be erroneous; but it has this advantage, that it is a name given to one kind of malady, and it is very generally understood to have but this one meaning. "**Hernia**," on the contrary, has been employed in several different senses. Here it will be used as synonymous with "rupture."

Distinction between Ruptures and Internal Herniæ.—Ruptures are protrusions which form an external swelling at some point on the abdominal or pelvic wall. Therefore, the so-called "internal herniæ" and the herniæ of the diaphragm are excluded from consideration in the following pages.

Site of Ruptures.—Ruptures occur with greatest frequency at those places where an opening in the abdominal wall naturally exists. Thus the commonest of all ruptures is the **inguinal**, which leaves the belly by the internal inguinal ring. Next in frequency are the **femoral**, which escape at the inner side of the femoral vein, and the **umbilical**, which protrude at the navel.

Nomenclature.—External herniæ of the abdomen have been named either according to the contents of the sac, or to the site of the aperture of exit. The word "hernia" itself, from ἔρνος, a branch, and the Latin *ramex*, denote merely the projection of the rupture. The ancients, in applying the term κήλη (a swelling), to scrotal tumours, combined it with a word which denoted the contents of the swelling. Thus **enterocele** meant in old times a scrotal intestinal rupture; **epiplocele**, a scrotal omental rupture. These terms at length became restricted in signification, and have long ceased to denote the place of the hernia. A rupture in any position containing bowel or omentum is called enterocele or epiplocele, as the case may be. Bubonocele indicated the place of the protrusion, and is now limited to those inguinal herniæ which have not passed the external inguinal ring, whilst scrotal hernia was named **oscheocele**. **Omphalocele** or **exomphalos** are still sometimes used for umbilical herniæ.

An inguinal hernia is sometimes called *incomplete* when it is a bubonocele, and *complete* when it has passed the external ring. Garangeot, however, spoke of a complete hernia when a whole loop of bowel was in the sac, and of an incomplete hernia when a part only of the wall of the gut was in the opening. This latter condition is now called *partial enterocele*, or *lateral enterocele*. Lawrence, again, gives still another meaning to these terms.

Traumatic Hernia.—The belief of the ancients and mediævals that herniæ are produced by bursting or tearing of the peritoneum has long been discredited; but under certain circumstances a protrusion may occur as the result of injury, and this is designated **traumatic hernia**. These herniæ, whether they appear immediately or some time after the receipt of injury, are always found at the site of the lesion. A man who had been struck by a buffer came under the care of the late Mr. John Gay

with a swelling as large as a cocoa-nut at the centre of the abdomen. On dissection, some of the viscera were under the skin and had come through a rent which divided the left rectus and left epigastric artery, the linea alba, and part of the right rectus muscle.[2] A case, almost identical, is quoted by Meckel from Plaignaud,[3] and another occurred in the practice of Mr. Bryant at Guy's Hospital. Such cases, however, are quite exceptional.

The ordinary traumatic hernia appears after the healing of a wound, or of an abscess of the abdominal wall. In a certain number of these cases the cicatricial tissue yields at length before the intra-abdominal pressure, and a hernia results. It is not now uncommon to find a traumatic hernia after the operation for ovariotomy, at the lower part of the scar. Occasionally, a blow on the abdomen is followed by thinning and absorption of the tissues between the peritoneum and the skin, whence arises a traumatic hernia.

Abnormal Types.—There is a rare anomaly of development sometimes designated hernia, which has been detected, for the most part, only in monsters, and which may be briefly mentioned here. The bowel lies in the spinal canal, or protrudes at the back from between the vertebræ.[4] An American surgeon is said to have found a hernia of this kind in a new-born child, projecting between the last dorsal and first lumbar vertebræ. After reduction of the gut, the bones were fastened together by suture, and the child made a good recovery.[5]

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2. **Gay.**—Path. Soc. Tr., 1864, vol. xvi.
3. **Meckel.**—Handb. d. Path. An., 1812, ii. 362.
4. **Levy.**—Müller's Arch., 1845, p. 22.
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CHAPTER II.

STATISTICS OF INGUINAL AND FEMORAL HERNIA.

Some writers have attempted to show that different races of men vary in their disposition to hernia; but hitherto all such endeavours have been fruitless, for no one has yet determined beyond dispute the proportion of ruptured persons in any single population.

Prevalence of Hernia in the Population.—Those who have sought to estimate the prevalence of hernia in a population have generally based

their calculations on the results obtained by examining the inmates of schools or of charitable institutions. In like manner, the percentage of ruptured youths has been obtained from the several Recruiting Lists. But all these estimates fall short of the truth, because they relate to the prevalence of hernia only at certain periods of life. And there is, besides, no close agreement among the results of different authors, so that in the statistics derived from workhouses and infirmaries, the proportion of ruptured persons varies from .8 to 20.1 per cent., and among recruits from .9 to 4.7 per cent.[1]

Malgaigne perceived the insufficiency of this method, and substituted another of greater promise.[2] He obtained from the Recruiting Lists the ratio of unsound to sound males between the ages of twenty and twenty-one. He next ascertained from a Statistical Table of ruptured persons the ratio between the patients of twenty years of age and the total number for all ages. Thus, by comparing these ratios, he could calculate the proportion of ruptured persons in the population, and found that it amounted to 5 per cent. A more careful examination of the Recruiting Lists used by him has, however, shown that he estimated the proportion of ruptured males between the ages of twenty and twenty-one too highly, and that the percentage should be 2.3 instead of 3.1, as quoted by him.[3] But, after admitting this correction, it must be observed that the results derived from the Conscription Lists are not trustworthy, for there is no general agreement between them; not only do the results vary when taken from different countries, but when taken from adjacent districts of the same country, with populations of the same character.

Malgaigne's corrected estimate gives 3.6 per cent. of ruptured persons in the population, but there are some reasons for thinking that even this valuation is too high.*

Statistics of Hernia.—The most notable Tables of the Statistics of Hernia are those of Dr. A. Wernher, published in 1869.

During ten years of Mr. Kingdon's administration at the City of London Truss Society, he prepared and published Tables of the cases treated

* Another mode of computing the proportion of ruptured persons in the population, which is also founded on a comparison of ratios, is, briefly, as follows:—

In a given number of ruptured persons there is a certain proportion who have recovered after the operation for strangulation, and likewise a certain proportion who have died after that operation. Hence, it is easy to calculate the number of living ruptured persons which corresponds to a given number of those who have died after the operation for strangulation. And as each death corresponds to a certain number of the general population, this ratio, compared with the preceding, gives the number of ruptured persons in the population.

This method, however, is not sufficiently exact to warrant a lengthy description of it, and of the reservations necessary in using it. In the population of London, according to this mode of calculation, .85 per cent. are ruptured, or 1.5 per cent. of the male population, and .24 per cent. of the female.

every year. These were Annual Tables, and there was no necessity to eliminate in any year, from the number of persons treated, those who had attended in previous years. Unaware, however, of the constant recurrence in those Tables of the same cases, Dr. Wernher added up Mr. Kingdon's Tables from 1860 to 1867, and formed one large Table, which he has made the basis for his exhaustive treatise on the Statistics of Hernia.

The chief advantage of this method is the magnitude of the numbers from which the deductions are drawn, and on this account it is much to be desired that the Tables of this author could be utilised here. But it is evident that such Tables are subject to two defects, which seriously affect their accuracy. Firstly, as a great many of the patients appear year after year at the Truss Society, if the Annual Tables are combined in one, the same case is often repeated over and over again, and there are a vast number of what Malgaigne called "double entries." The result is, that a Table, thus composed, does not exhibit the herniæ observed in a given number of persons, but the number of trusses distributed by the Truss Society in a given time to an unknown number of persons. It was not till 1888 that a change was made in the mode of keeping the records at the Truss Society, whereby it became possible to combine the cases of several years without the occurrence of repetitions. With the records before 1888, this could have been done only by an expenditure of labour quite out of proportion to the object in view; and, in fact, the task has never been attempted.

In the second place, Mr. Kingdon arranged the cases of each year in two Tables. In one, the patient was entered under the age at which the hernia first appeared; in the other, according to his age at the time of his visit to the Truss Society. The totals of these two Tables should be the same, but they are not, perhaps because the country cases were included in one Table and not in the other. Therefore, when Dr. Wernher forms two Tables by arranging the same cases in different ways after Mr. Kingdon's plan, there is a large discrepancy between the sums total.

For these reasons it has been thought necessary to construct new Tables, and it may be here stated that in all the Tables used in this book, each integer stands for a patient, and each patient is represented only once.

Explanation of Tables.—The following Tables, which relate to inguinal and femoral hernia, comprise 20,999 persons. The Male cases are in Table I., and the Female in Table II. Each Table is divided into two parts. In Part I. the patient is entered according to his age and the side ruptured* at the first appearance of the hernia; in Part II. the patient is entered according to his age and to his rupture or ruptures at the time of his visit to the Society. The total in Part I. is equal to the total in Part II. Part II. necessarily consists of three sections, of Inguinal, of Femoral, and of the combinations of Inguinal and Femoral Herniæ.

* This plan was used by Verdier in 1840, and later by Mr. J. A. Kingdon.

TABLE I.

PART I.—*Male Cases seen at the Truss Society in the Years* 1888, 1889, 1890, *entered according to the Age and Side affected when the Hernia first appeared.*

	TOTAL.	Under 1.	1–5	6–10	11–15	16 20	21 25	26–30	31 35	36–40	41 45	46 50	51 55	56 60	61 65	66 70	71–75	76–80	81–85	86–90
§ I.																				
Inguinal.—Right	10,082	2,020	463	233	360	943	1,025	918	835	737	663	607	449	334	251	140	45	26	3	...
,, Left	6,630	734	175	137	233	641	816	716	670	596	515	472	341	277	177	90	36	1	3	...
,, Double	826	404	32	20	11	32	37	40	49	49	45	30	28	16	17	4	3	...	.	...
	17,538	3,158	670	390	634	1,616	1,878	1,680	1,554	1,382	1,223	1,109	818	630	445	234	84	27	6	...
§ II.																				
Femoral.—Right	268	..	.	6	8	12	12	28	30	37	24	41	19	21	17	6	7	...	...	...
,, Left	181	..	.	4	3	13	16	25	20	15	22	20	16	12	11	3	...	1	...	...
,, Double	12	..	..	1		.	1	1	2	1	3	1	1	...	...	1	...	...	...	...
Total males, **17,999.**	461		...	11	11	25	29	54	52	53	49	62	36	33	28	10	7	1	...	...

PART II.—*Contains the same Cases as Part I., entered according to the Age of the Patient and the kind of Rupture at the time of his visit to the Society.*

§ I.																				
Inguinal.—Right	6,685	566	759	317	254	327	420	485	500	522	458	518	403	410	260	268	121	53	14	...
,, Left	3,884	170	237	115	102	171	262	330	393	388	347	349	265	289	234	141	66	34	7	..
,, Double	6,800	259	280	125	132	143	253	362	480	604	627	705	692	732	579	458	284	87	24	7
	17,429	992	1,276	557	488	641	955	1,177	1,373	1,514	1,432	1,629	1,330	1,428	1,103	867	471	174	45	7
§ II.																				
Femoral.—Right	172	.	.	1	3	1	3	10	10	18	16	12	25	19	14	10	10	...	..	.
,, Left	111			2	1	4	11	2	4	10	11	12	18	9	16	7	3	1	..	..
,, Double	90	..	..		.	2	1	4	2	6	13	8	14	12	9	9	5	5	...	...
	373	...	...	3	4	7	15	16	16	34	40	52	57	40	39	26	18	6	...	...

Combinations of Inguinal and Femoral.

§ III.																				
Double inguin. and double fem.	26	...	..		.	.	.	1	1	2	..	4	1	2	8	3	2	1	...	1
Double inguin. and right fem.	19	..	...		.	.	.	.	.	2	1	6	...	3	3	...	3	1	...	...
Double inguin. and left fem.	12	...	...	.	.	.	.	.	1	.	3	1	1	...	3	1	1	...	1	...
Double fem. and right inguin.	9	...	..	.	.	.	.	.	.	3	..	1	1	.		2	1	1	.	...
Double fem. and left inguin.	7	...	...	.	.	.	.	.	.	.	..	..	..	3	2	2	..	...	.	...
Right inguin. and right fem.	14	...	...	.		.	1		.	1	1	3	1	2	2	3	...		...	...
Right inguin. and left fem.	46	...	...	...	..	...	1	1	.	2	1	6	10	9	5	7	3	1	...	...
Left inguin. and right fem.	61	...	...	...		1	.	..	6	8	5	5	3	12	11	6	4	..	..	...
Left inguin. and left fem.	3	...	...	...	..	..		1		..	1	...	...		1	...	...	...	...	...
Total males, 17,999.	197	...	..	...	..	1	2	3	8	18	12	26	17	31	35	24	14	4	1	1

TABLE II.

PART I.—*Female Cases seen at the Truss Society in the Years* 1888, 1889, 1890, *entered according to the Age and Side affected when the Hernia first appeared.*

	TOTAL.	Under 1.	1–5	6–10	11–15	16–20	21–25	26–30	31–35	36–40	41–45	46–50	51–55	56–60	61–65	66–70	71–75	76–80	81–85	86–90
§ I.																				
Inguinal.—Right	908	138	114	74	60	86	104	99	76	61	36	20	11	7	10	9	3	...	...	...
,, Left	816	104	69	46	40	73	117	82	96	73	42	23	14	18	11	6	1	1	...	...
,, Double	79	33	15	9	2	...	3	6	3	2	1	2	...	...	1	...	2	...	...	...
	1,803	275	198	129	102	159	224	187	175	136	79	45	25	25	22	15	6	1	...	...
§ II.																				
Femoral.—Right	747	...	4	6	17	48	98	125	111	96	87	50	39	29	22	7	6	2	...	...
,, Left	435	...	1	5	9	38	67	56	75	63	53	15	17	18	8	5	5	...	...	...
,, Double	15	...	...	...	..	7	2	...	1	1	1	1	...	1	1	...	...	...	...	...
Total females, **3000.**	1,197	...	5	11	26	93	167	181	187	160	141	66	56	48	31	12	11	2	...	...

PART II.—*Contains the same Cases as Part I., entered according to the Age of the Patient and the kind of Rupture at the time of her visit to the Society.*

§ I.																				
Inguinal.—Right	697	38	70	66	63	43	71	73	42	56	48	37	26	19	21	13	7	3	1	...
,, Left	612	45	40	38	28	34	51	58	59	56	52	38	30	29	19	24	6	4	1	...
,, Double	468	31	21	17	23	27	37	31	34	46	45	39	35	28	17	22	10	2	1	2
	1,777	114	131	121	114	104	159	162	135	158	145	114	91	76	57	59	23	9	3	2
§ II.																				
Femoral.—Right	591	...	1	1	3	14	21	47	49	62	72	94	54	55	44	34	27	12	1	...
,, Left	308	...	...	3	1	1	8	18	33	38	51	43	27	22	22	23	14	3	1	...
,, Double	260	...	...	...	...	2	8	9	15	31	35	33	28	31	27	19	15	4	3	...
	1,159	...	1	4	4	17	37	74	97	131	158	170	109	108	93	76	56	19	5	...

Combinations of Inguinal and Femoral.

§ III.																				
Double inguin. and double fem.	2	...	...	...	...	...	...	...	...	...	...	1	...	...	1	...	...	...	...	...
Double inguin. and right fem.	2	...	...	...	...	...	...	...	...	...	...	1	...	1	...	...	...	...	...	...
Double inguin. and left fem.	3	...	...	...	...	...	...	...	...	...	1	...	...	...	...	2	...	...	...	...
Double fem. and right inguin.	3	...	...	...	...	...	...	...	...	1	...	...	...	...	...	1	1	...	...	...
Double fem. and left inguin.	2	...	...	...	...	...	...	...	...	1	...	...	...	1	...	...	...	..	...	...
Right inguin. and right fem.	5	...	...	...	...	1	...	...	2	1	...	...	...	1	...	...	...	...	...	...
Right inguin. and left fem.	17	...	...	...	...	...	...	...	3	1	...	2	4	2	2	2	1	...	...	...
Left inguin. and right fem.	27	...	...	...	...	...	...	...	4	3	5	3	3	4	1	2	...	1	1	...
Left inguin. and left fem.	3	...	...	...	...	...	1	...	...	1	...	1	...	...	...	...	...	...	...	...
Total females, 3000.	64	...	...	...	...	1	1	...	9	8	6	8	7	9	4	7	2	1	1	...

Relative Frequency of Hernia in the Two Sexes.—All writers are agreed that the male sex is more subject to hernia than the female. J. L. Cloquet concluded from a number of dissections that men are ruptured 2.4 times as often as women,[4] and Mr. Kingdon has lent the authority of his great experience to support this opinion. There are, however, certain considerations which make it probable that Cloquet was in error, and evidence can be obtained from Mr. Kingdon's own Tables to justify the acceptance of a higher proportion for males.

If a large number of cases of groin ruptures are taken (see Table I.), the femoral hernia among males will be found to amount to 2.5 per cent.; but Cloquet gives 18 per cent. of femoral cases in males. Again, the proportion of inguinal to femoral among women is 60.3 : 39.7 per cent. (see Table II., Part I.): but this is reversed by Cloquet, who makes 34.7 per cent. inguinal, and 65.3 per cent femoral. This proportion shows that Cloquet computed from adults only, and he also used but a small number (121) of instances.

Mr. Kingdon, in adopting Cloquet's estimate of 2.4 : 1 in preference to the 5.5 : 1 (male : female) of his own Table,[5] supposed that a number of women are deterred by motives of delicacy from applying to the Truss Society for relief. To test the effect of this influence, Part II. of Tables I. and II. may be consulted, wherein the patients are arranged according to their ages at the time of their visits to the Society. A Table constructed in the same way is given by Mr. Kingdon, and differs from this only in having a smaller sum total.

If a comparison is made of the numbers of each sex that apply before the age of sixteen, so as to avoid the abstentions due to modesty, there are 6.7 males ruptured to 1 female. Again, compare the numbers after fifty years of age, during which period scruples of delicacy are not likely to be pressing, and the proportion is 7.0 males to 1 female. During the interval from sixteen to fifty years, when Mr. Kingdon's objection has its greatest value, there is a larger proportion of visits to the surgeon by women than at the earlier or later periods of life, *i.e.*, male : female = 5.2 : 1. There is not, therefore, any valid reason for refusing to the figures in Tables I. and II. their literal signification, which indicates that 5.9 males are ruptured to 1 female. This estimate is higher than Malgaigne's,[6] whose ratio is 4 : 1, but it is likely that his estimate would have been higher if he had used a larger number of cases; unless, indeed, Frenchwomen in his time were more disposed to rupture than Englishwomen in our own.

Relative Frequency of Inguinal and Femoral Hernia in the Two Sexes.—By referring to Tables I. and II., Part I., the distribution of inguinal and femoral hernia between the sexes may be ascertained. For example, among 100 ruptured persons are—

	Per cent.
Male inguinal	83.5
Female inguinal	8.5
Female femoral	5.9
Male femoral	2.1

The surpassing frequency of male inguinal hernia, which occurs nearly six times as often as all the other divisions taken together, is thus well seen, as also the very humble proportion of femoral hernia in males. The rarity of femoral hernia in comparison with inguinal is all the more remarkable, as the passage, by which the femoral comes, seems more favourably placed than the inguinal ring for the escape of the viscera, and is, according to some authorities, a larger opening. The simplest explanation is that of Meckel, who observed that the femoral ring is not, like the inguinal, originally open, nor under normal circumstances do organs make their way through it.

Distribution of Inguinal and Femoral in Males and in Females.—The frequency of inguinal and femoral in each sex taken separately may be stated as follows :—

In 100 men ruptured 97.5 per cent. have inguinal, and 2.5 per cent. femoral hernia. Among 100 women ruptured, 60.3 per cent. have inguinal, and 39.7 per cent. femoral hernia. The preponderance of inguinal over femoral in women is seen to prevail, whichever of the two parts of Table II. is made use of, and has been found constant in several other Tables, drawn up by the author, not here given. The result confirms the experience of Malgaigne,[7] but differs from that of Mr. Kingdon, who has drawn from the same source as the author, but at an earlier period. The discrepancy is probably due to the fact that Mr. Kingdon employed only a small number of cases for comparison.

Such differences as these can be easily adjusted, but there are errors arising from the ignorance or indifference of the patients which no care or diligence can wholly prevent. Poverty seems to dull the remembrance of things which it is scarcely possible that any man or woman could fail to keep in mind. The poor forget their ages, the number of their brothers and sisters, and even sometimes the number of their children. And thus, though the figures given in Tables I. and II. may be considered accurate in respect to the nature of the hernia and the side affected, for these facts were observed at the Truss Society, they can be only approximately true in respect to the ages of the patients and the date of the first appearance of the hernia. It is necessary to make this admission before inquiring into the prevalence of hernia at different periods of life.

Prevalence of Hernia at Different Periods of Life.—In the first

year of life a larger number of persons are living, and a larger proportion are ruptured, than in any subsequent year. Of 1000 males living, 31 are in their first year; and of 1000 ruptured, 175 are affected in their first year. Of 1000 females, 27.5 are living under one year of age, and there are 91.6 under one year per 1000 ruptured.

This extraordinary frequency of hernia in the first year in males, and to a less degree in females, is in strange contrast to the small number which develop in the years immediately succeeding. Death from strangulation has no part in causing this decline in frequency from the age of one to ten. Camper observed the high position of the bladder in the new-born, and satisfied himself that after three or four years the cavity of the pelvis has become so roomy, that the bladder for the most part lies therein.[8] He conceived that, whilst the bladder occupies the abdomen, the inguinal rings are much exposed to the pressure of the viscera; but that when the bladder sinks into the pelvis, the pressure on the rings is less powerful and less direct. Thus he explained the diminution in the production of hernia as childhood advances. Malgaigne, on the other hand, surmised that ruptured children are subject to a peculiar delicacy, which causes a mortality amongst them far beyond the average. It is more probable, however, that the closing of the abdominal rings and the building up of the posterior wall of the inguinal canal, as growth proceeds, determine the lessening tendency to hernia in childhood. As Mauriceau observed, the gut enlarges in proportion to all the other parts of the body, but the place dilated tends to shrink.[9]

A large increase in the production of ruptures occurs in youths between eleven and fifteen, and in maidens between sixteen and twenty. This may be in part attributed to the active exercises and employments in which they begin to engage.

It will not be requisite to follow M. Malgaigne and Mr. Birkett in their division of life into two halves at the age of thirty-five, for there is nothing in the Statistical Tables to suggest such a division; but as the latter author has found that hernia occurs more frequently in the last half of life than in the first half, the statement requires examination.[10]

Mr. Birkett has used a Table of Mr. Kingdon's with a total of 9296 persons, together with the Census for 1851, and after making a correction for loss by death in the population, concludes that 41 per cent. are ruptured before the age of thirty-five, and 59 per cent. after thirty-five. This result is somewhat modified if the sexes are tabulated separately. When the calculation is repeated whilst using Part I. of Tables I. and II. with the Census of 1881, and when an allowance is made by the same method as that used by Mr. Birkett for loss by death in the population, the result is as follows:—

	From Birth to the Age of Thirty-five.	From Thirty-five to End of Life.
Males ruptured . .	43.2 per cent.	56.6 per cent.
Females ruptured .	51.8 „	48.1 „

A clearer view of the prevalence of hernia at different ages is gained by comparing the numbers from birth to fifteen, from sixteen to fifty, and from fifty-one to the end of life. If Mr. Birkett's plan be used, whereby the changes in the population at different periods are equalised, the numbers are as follows :—

	Birth to Fifteen.	Sixteen to Fifty.	Fifty-one to End of Life.
Males ruptured .	25.4 per cent.	37.5 per cent.	36.9 per cent.
Females ruptured .	29.6 „	47.1 „	23.1 „

When no correction is made for the decline in the numbers of the population the figures are—

	Birth to Fifteen.	Sixteen to Fifty.	Fifty-one to End of Life.
Males ruptured .	27 per cent.	59.8 per cent.	13.1 per cent.
Females ruptured .	24.8 „	66.6 „	8.4 „

Whichever of these schemes is preferred, both show that the greatest number of herniæ are developed during the most active part of life, and that age lessens their frequency. Perhaps it would be more just to say that the tendency to hernia increases with age, but that the exciting causes are less active. After fifty there is a much greater reduction in the formation of hernia in women than in men, and it is this which makes the percentage of hernia in the early years of life apparently so high among females (in the first scheme). The division of life into three periods, above adopted, is indicated by Tables I. and II., and the reasons for it will be apparent when the exciting causes of rupture are considered.

Prevalence of Inguinal and Femoral in the Two Sexes at Different Periods of Life.—The statements just made as to the prevalence of groin ruptures in the male at different periods of life are equally true of inguinal rupture in the same sex, in which this hernia occurs with such frequency as to overshadow the effect of the femoral cases when the two are taken together. In the female the distribution of inguinal and femoral is more equal. During the early years of life, inguinal is found almost alone ;* but in the child-bearing period (16–50), the femoral cases are nearly equal to the inguinal, and after fifty the femoral are slightly in excess.

When the two sexes are compared in respect to the incidence of inguinal hernia at different ages, it is seen that up to sixteen the male cases are 6.8 times more than the female ; from sixteen to fifty they are 10.3

* Dupuytren remarked the greater frequency of inguinal herniæ in young girls.

times; and from fifty to the end of life they are 23.8 times more numerous than the female cases. Hence it appears that the tendency to inguinal hernia in the female wanes earlier than in the male. Or perhaps the case might be better expressed by saying that the tendency to the production of inguinal in males hardly diminishes at all as age advances. Men are subject to this peculiarity, from which women are almost free, that they develop after forty years of age direct herniæ, and to such a degree as to make a considerable addition to the number of ruptures. This fact may explain in some measure the increasing difference in the proportion of inguinal herniæ in the two sexes in the latter part of life. The same kind of difference is observed when the femoral cases are compared, for though this hernia is more frequent at all ages in women than in men, the ratio is much less after fifty than before.

Femoral cases . . .	16 50	51–85.
Male : Female	1 : 3.07	1 : 1.3.

It appears, therefore, that the tendency to groin ruptures in women lessens after fifty more rapidly than in men, and this peculiarity probably depends, as will be shown in a subsequent chapter, upon the earlier cessation of the exciting causes in women.

It has been asserted that femoral hernia is more frequent in boys than in girls, and as the statement has obtained some currency, it requires examination.[11] In the accompanying Table, the cases of femoral hernia, from 1873 to 1882 inclusive, have been arranged according to the age of the patient when the rupture was first noticed, from one year to twenty. The cases here given form part of an aggregate of about 5300 femoral herniæ. The preponderance of the female over the male cases is manifest at the earliest age, and increases every year.

Cases of Femoral Herniæ, 1873–1882.

	Total.	1–5	6–10	11–15	16–20
Males	134	7	19	29	79
Females	338	8	22	50	258

The same result is found on comparing Tables I. and II., Part I., § II. in each.

Of Double Hernia.—Among herniæ at the time of their first appearance, 4.6 per cent. are formed on both sides at once in males, and 3.1 per cent. in females; and these cases occur chiefly in inguinal herniæ, and in the first few years of life (in males 48.9 per cent., and in females 41.7 per cent. of these doubles are under one year). But as life advances, a great

number of single herniæ become double, and the extent to which this occurs can be estimated from the second part of Tables I. and II. Thus it appears that among males 36.6 per cent., and among females 23.3 per cent. of single herniæ become double. Hence it is evident that there is a greater tendency to the formation of double herniæ among males than among females. If inguinal and femoral herniæ are considered separately, it is found that there is a greater tendency to double inguinal than to double femoral in each sex; and that the tendency to double inguinal and double femoral is greater in males than in females.

The increase in the production of double inguinal in males with increase of age is very striking. Between twenty and fifty double herniæ are formed from single in large numbers, but the production of single herniæ during the same period is so great that the single outnumber the double. After fifty, there is a continuous fall in the production of single herniæ; but the double (formed from pre-existing single herniæ) continue to occur, and are more numerous than both right and left taken together.

If the totals in § I., Part I., of Table I. are compared with the totals in Table I., Part II., it is found that 41.4 per cent. of the cases of inguinal hernia, which first appeared on the left side, become double, and that 33.6 per cent. become double of those that occurred first on the right side. The difference is less marked, but still apparent, in femoral hernia, the numbers being 38.6 per cent. for the left side, and 35.8 per cent. for the right. Hence there is a greater tendency for a left than for a right hernia to become double in the male.

In females, 25 per cent. of left inguinals and 23.2 per cent. of right inguinals become double, whilst 29.1 per cent. of left femorals and 20.8 per cent. of right femorals become double. This result is contrary to that which obtains among males, in whom left inguinal, not left femoral, shows the strongest disposition to become double. The differences in the disposition to form double hernia correspond to the different tendencies of the two sexes to form hernia on the right side. During a part of life in males there is an extraordinary disposition for an inguinal rupture to form on the right side, and this accounts for the high percentage (41.4) of left inguinal herniæ that become double; but in females this preference for right inguinal before left does not exist. The tendency to the formation of right femoral is stronger in women than in men, and this accounts for the greater tendency of left femoral to become double in the former sex.

The greater tendency of left hernia to become double is also demonstrated by finding the ratio of single rights to single lefts in the Tables, and comparing the ratios from the sections of Part I. with those from the sections of Part II. The proportion of single right hernia, whether

femoral or inguinal, derived from the Table giving the side affected at the first appearance of the hernia (Tables I. and II., Part I.), is less than the proportion of right singles in the Table which gives the side ruptured at the time of the examination of the patient (Tables I. and II., Part II.), that is, a greater number of left than of right herniæ have been absorbed to form double ruptures.

TABLE III.

Constructed from Tables I. *and* II.

	Males.		Females.	
	Inguinal.	Femoral.	Inguinal.	Femoral.
Ratio of right to left at age of origin of the hernia . .	1.5 : 1	1.4 : 1	1.11 : 1	1.7 : 1
Ratio of right to left at age at time of examination . .	1.7 : 1	1.5 : 1	1.13 : 1	1.9 : 1

Incidence of Right and Left Hernia.—The proportion of right herniæ to left varies, not only according to the kind of hernia and to the sex, but in the same sex at different periods of life.

The difficulty of explaining these alternations is greater in regard to femoral than to inguinal hernia, firstly, because less is known of the cause of the femoral; and secondly, because we possess no trustworthy statistics of large dimensions concerning this hernia, so that the ratios for comparison, being drawn from an inconsiderable number of cases, are uncertain. The defect arising from this source is present in the following Table, in the part which relates to femoral hernia, and so far diminishes the value of its testimony. Throughout the Table the figures indicate the ratio of right hernia to left, and left always = 10. In the first column, which concerns inguinal in the male, the right herniæ are seen to be most frequent under one year; the ratio then gradually declines, and from the twentieth to the sixtieth years the two sides are affected almost equally. Towards the close of life the right again become more common. The great preponderance of right herniæ in the first year, and their high proportion till after puberty, have been long supposed to be connected with the later descent of the testis, that is, with the later closure of the inguinal canal on the right side. This influence appears to lose its ascendency after puberty, for, beyond the age of twenty, the left ruptures become nearly as frequent as the right.

TABLE IV.

Table showing the Ratio of Right to Left Hernia at Different Periods of Life. Throughout the Table Left = 10.

	Inguinal.				Femoral.			
	Male.	Female.			Male.	Female.		
Ratio of right to left for the	R.	R.			R.	R.		
whole of life . . .	15	11			14	17		
Under 1 year . . .	27	13						
1 to 10	22	16						
11 to 20	15	12			12	13		
21 to 30	12	10			9	18		
31 to 40	12	8			19	15		
41 to 50	12	8			15	20		
51 to 60	12	5	8	15	14	19		
61 to 70	14	11	8	14		22		23
71 to 80	19		12					19
Birth to 15	24	14						
16 to 50	12	9			14	16		
51 to end of life . . .	13	7			16	19		

This Table is constructed from Part I. of Tables I. and II. The figures at the side are ratios calculated from the cases which came to the Society during the ten years 1872–1883.

The increased production of those on the right in old age, which occurs both with inguinal and femoral, can be traced in these columns, and is a fact which authors seldom allude to, and have never explained.

In the female sex, during early life, right inguinal herniæ are the more frequent, which corresponds to the later obliteration of the canal of Nuck on the right side; but the difference between right and left is less than it is in boys, in whom anomalies happen more often in the closing of the abdominal openings. In women from twenty to seventy, the two sides are affected nearly equally, and in the accompanying Table the left slightly predominates. At the end of life, the right herniæ again become more numerous, as they do in males. The columns for femoral hernia show that there is a greater tendency to this hernia on the right in women than in men, and that the tendency increases somewhat towards the end of life. The small number of cases in the original Tables (Tables I. and II.) accounts for the irregularity of the figures in these columns; and, for the same reason, the ratios do not admit of very precise application.

It is needless to consider further the causes of the preponderance of right inguinal herniæ over left. It has been variously explained by the use of the right hand in preference to the left,[12] by the weight of the

liver,[13] and by the inclination of the mesentery towards the right iliac fossa.* [14] Malgaigne attributes this last suggestion to Martin, but it is found in Velpeau. It appears to have been accepted by the late Mr. Callender in respect to femoral ruptures, and has more recently been applied by Mr. Lockwood [15] to explain, as Velpeau did, the predominance of right herniæ in general. Sir Astley Cooper conjectured that the difference in frequency of right and left femoral was owing to the greatest exertions being made on the right side. A more probable explanation was given by Dr. Knox, who thought that "the cause depended on the larger capacity of the right side of the pelvis compared with the left." [16]

That the right half of the pelvis is greater than the left is not unlikely, considering that the right half of the abdominal girth is greater than the left,† and some observations of the author render still more probable the statement of Dr. Knox. Twenty-seven pelves were traced with the Cyrtometer along a line just below the crest of the ilium and along the upper border of the pubes. The two sides were found to be equal in size in five cases, the left side was the greater in five, and the right greater in seventeen cases. All these tracings were taken from males of different ages. So far as this limited number of observations goes, the right half of the circumference of the pelvis appears to be generally greater than the left.

If the right half of the pelvis, and, consequently, the right crural opening, is generally larger than the left, this circumstance may suffice to determine the higher proportion of right femoral herniæ compared with left. With the advance of age and of its debilitating influences, if the tendency to femoral hernia in general is augmented, the result would be a greater proportion of right herniæ.

The inclination of the mesentery to the right completely fails to explain the difference in the tendency to right femoral hernia in males and females. But if the right crural ring in both sexes is larger than the left, the preponderance in both of right femoral hernia is accounted for; and as the crural rings are known to be larger in women than in men, the higher proportion of right herniæ among them is explained. The increased tendency to femoral hernia in old age, from weakening of

* Camper says that Purman explained the greater frequency of right herniæ on the ground that we put the right foot foremost in walking (Kleine Schriften, 1785, vol. ii. p. 59). Verdier's explanation is that we generally lie on the right side (Mem. de l'Acad. Roy. de Chir., vol. ii. p. 40).

† Dr. Fred. Tuckermann measured the abdominal girth in fifty students of the Massachusetts Agricultural College, whose average age was 19.6 years. He found a considerable difference in favour of the right side. (Jour. Anat. and Phys., xix., p. 308, April 1885. "Some Observations in reference to Bilateral Asymmetry of Form and Function.")

the abdominal wall, &c., is equivalent to an enlargement of the femoral openings, and if the right opening is already larger than the left, the proportion of right herniæ must rise.

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CHAPTER III.

THE CAUSES OF HERNIA—HISTORICAL INTRODUCTION.

Hernia among the Ancients.—Among the relics of early Greek surgery are a few passages concerning the treatment of hernia, but scarcely anything regarding the cause of the malady beyond this, that it is due to "injury or to distension." *

Not till the time of Galen was the question dealt with at greater length. The various paragraphs which he has devoted to this subject show that he considered hernia to be an affection, not only of the peritoneum, but of the aponeuroses of the abdominal muscles.[1] He takes care to explain that there is either a breaking or a widening of the aponeuroses, as well as of the peritoneal layer at the site of the hernia. The sudden occurrence of a hernia of large size could only be understood by supposing

* The knowledge of hernia possessed by the writers of antiquity has been admirably set forth by Prof. Albert in his Beiträge z. Gesch. der Chir., ii. Heft. Die Herniologie der Alten, 1878.

that the layers of the abdominal wall were broken or ruptured. If it had been possible for Galen to practise the dissection of human bodies, this mistake would soon have been discovered; but the savage superstition of that age made such investigations dangerous. Hence he was committed to this error, and to another not less notorious. Galen supposed that the tunica vaginalis, which he found patent in monkeys, must be likewise open in man, and therefore, that in hernia it was the orifice of the processus vaginalis which was dilated or ruptured.

Hernia in Later Times.—It was not till the middle of the sixteenth century that Fernelius discovered that the peritoneum is nowhere perforated.*[2] The subperitoneal tissue he described as an outer layer of the peritoneum, from which a loose sheath, enclosing the spermatic vessels, was derived. There was still, therefore, a process of so-called peritoneum about the vessels of the cord, but of a nature very different from that designated by Galen. Many years, however, elapsed before Galen's Anatomy was superseded, and it held sway till the middle of the seventeenth century, when the description of Fernelius was generally adopted. At length Ruysch (1691) demonstrated that the subperitoneal tissue is not properly a layer of peritoneum, but part of the general connective tissue of the body.[3]

The doctrine that in herniæ of slow formation the peritoneum was stretched, and in those occurring suddenly the peritoneum was torn, may be found in Paulus,[4] though probably it might be traced further back. And as clinical observation must have shown that the majority of herniæ form gradually, the majority must have been considered herniæ from dilatation, and this Rhases admits when he says "in ordinary cases there is no rupture." This statement occurs again in some of the surgical writings of the Middle Ages,† but seems to have fallen into neglect till the latter end of the sixteenth century. Many surgeons then living believed that herniæ could only occur by stretching of the peritoneum.[5] At the end of the seventeenth century Ruysch came to the same conclusion by the aid of dissections.‡[6] Nevertheless, rupture of the peritoneum was generally mentioned as a cause of hernia till the time of Haller, but seldom after that period. Up to the final disappearance of the error, many had detected and exposed it; but the majority of writers still clung to the doctrine of Galen and of Paulus, that hernia may be due either to dilatation or to rupture of the peritoneum.

The further question, "What causes dilatation of the peritoneum and

* In 1687 Stephen Blancard stated that the processes (vaginal) are closed in man, but open in dogs and other brutes (Anat. Reform., 1687, cap. xxxiii. p. 273). Nuck also in 1696 makes the same assertion (Adenograph. Curios. Cap. Dec., p. 130).

† Lanfranc, Guido, Valescus.

‡ Mery is sometimes credited with establishing this doctrine.

of the hernial rings?" has been much discussed by surgeons in the last century and in this. Before examining the different theories put forth by them, it will be desirable to consider the various circumstances which appear to be related to the production of hernia. The causes of hernia are so imperfectly known, that a very large number of circumstances and acts have been enumerated by different writers as conducing to this end. Many of the so-called "causes," such as the ingestion of various foods and drinks, have no relation to the subject of hernia. Some are still more frivolous. A grave person at the beginning of this century received a prize for an essay which he wrote to prove that swaddling-bands and high breeches cause ruptures. Again, in 1889, an American surgeon associated the production of hernia with disease of the upper air-passages;[7] and in 1856 a theory was propounded by a French savant more extraordinary still. After adverting to the long cæcum possessed by herbivorous animals and the nature of their food, he observes that the poor, who are so commonly ruptured, live chiefly on a vegetable diet. Therefore the cæcum in the poor tends to lengthen, and a long cæcum, like a long mesentery, as some think, predisposes to hernia. Notions so fanciful and so remote can find no place in any serious inquiry into the causes of hernia, and no further allusion will here be made to them or to others of corresponding value.

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CHAPTER IV.

PREDISPOSING CAUSES IN GENERAL—INHERITANCE.

Uncertainty on the Question of Inheritance among Authors.—Though so many writers on hernia have treated of its acquisition by inheritance, very little has been done to determine the relation between hernia in the ascendant and hernia in the offspring. It has been generally assumed by Malgaigne and others that those cases of hernia, whose parents or grandparents were ruptured, have been cases of

inheritance. But this supposition is not attended by any proof that the disease is hereditary. In a given number of ruptured persons a small proportion only, varying from 22 to 28 per cent., give a history of hernia in the ascendants. The majority have no knowledge of the previous occurrence of the malady in the family, and if in so many the hernia arises from other causes, why should not those causes operate likewise in producing the hernia of the persons giving a family history?

The Proportion of Ruptured in the Progeny of the Ruptured.—If it were possible to ascertain the proportion of ruptured persons amongst the progeny of the ruptured, one would be able to find the difference in the proportion, if difference there be, corresponding to the different ascendants. In this way we might obtain some assurance that inheritance is an actual factor in the production of ruptures.

The information necessary for this purpose might be got by interrogating either the ruptured children as to their parents and collaterals (brothers and sisters), or the ruptured parents as to their children. But it is scarcely necessary to point out that the parent knows very little of the life-history of the child—so little indeed, that it has been found useless to examine the parent as to hernia occurring in his offspring. A ruptured person, however, may know something of the history of his parents and of his brothers and sisters, and though this is something short of the truth, it is a part of the truth.

Family Histories: Difficulties in the way of obtaining them.—With a view, then, to determine the proportion of ruptured children among the children of the ruptured, each of the patients at the Truss Society has been asked the following questions:—

1. Whether a parent or grandparent has been ruptured?
2. Whether any brothers or sisters have been ruptured?
3. How many brothers and sisters he or she has had altogether?

If the answers to these questions were correctly given, there would be little difficulty in estimating the proportion of ruptured children amongst the offspring of the ruptured, but there are two chief sources of error. Firstly, uneducated persons do not remember exactly the number of their brothers and of their sisters. They therefore guess the number, and it has been found that each sex exaggerates the numbers of that sex, and that the women, as might be expected, exaggerate more than the men. This error would in some measure correct itself if the women from whom the histories are obtained, that is, if the ruptured women patients were equal in number to the men, but the male patients preponderate so much (male to female 5.9 : 1) that the error of the women is over-corrected, and the result is that in the whole number of the offspring the proportion of males to females is much above the proportion of male to female births. Secondly, it is found that men know the ruptures of their brothers, but

not generally of their sisters; and, in like manner, women know the ruptures of their sisters, but not of their brothers—that is, the sexes do not usually communicate these facts to one another. So reticent, indeed, are people on the subject of this infirmity, that it is not uncommon for the fact to become known to relatives only after the death of the patient. Fabricius Hildanus speaks of a nobleman who concealed a large scrotal hernia for many years even from his wife. In consequence of these errors in the information thus obtained, the number of ruptured persons is too low, and the average number of persons in a family is too high.

Difference in the Proportion of Children Ruptured when the Ascendant is or is not Ruptured.—According to the erroneous computation of the patients the families consist on an average of 7.1 persons when only those families are taken which possess three members or more than three. It will be convenient, when comparing the different sets of families, to assume that each consists, on an average, of six members.

In the records of the Truss Society, in 1889 and 1890, there were 2639 families having either the father or the mother or both parents ruptured, and among these families 3586 persons were said to be ruptured. This gives an average of 1.35 persons ruptured per family, and this, as was explained above, must be less than the true proportion. Or if the families contained an average of six persons, 22.5 per cent. of the members were ruptured. Again, in families not subject to hereditary influence, if the proportion were one person ruptured per family, or 16.6 per cent., it is difficult to explain the increased proportion in the affected families except as the effect of inheritance. This effect comes out more clearly when the families are separated into (1) those with fathers ruptured; (2) with mothers; and (3) with both parents ruptured.

TABLE V.

	I.	II.	III.	IV.
Descent.	Number of Families.	Number of Ruptured.	Average of Persons Ruptured per Family.	Percentage of Ruptured Persons in Offspring.
With father ruptured . .	2,039	2,699	1.30	22.06
With mother ruptured . .	442	610	1.37	23.0
With both parents ruptured .	158	277	1.75	29.2

Average family = 6.

It will be observed that with equal numbers of fathers and mothers ruptured (Column IV., Table V.) the influence of one parent is almost equal to that of the other, a result that might have been anticipated.

On reference to Columns III. and IV. it appears as if with equal numbers of fathers and mothers ruptured, the effect of the mother was greater than that of the father. This will presently be found to be due, apparently, to the influence of the mother in augmenting the number of ruptured among her female children.

Influence of the Mother increases the Number of Ruptured Daughters.—To demonstrate this, Table V. must be broken up to show the proportion of males and females ruptured. On account of the inaccurate estimate made by patients of the numbers of their brothers and sisters, it will be convenient to disregard the numbers given by them, and to obtain the total of the offspring under each heading by multiplying the number of families by the average number of persons in a family (six), and dividing these whole numbers into two parts, representing the male and female children in the proportion of male to female births (103.8 : 100). The percentage of ruptured individuals among the male and female children is thus easily calculated, although the result does not, of course, indicate the true, but only the relative percentage.

TABLE VI.

Table showing the Relative, not Actual, Proportion (per cent.) of the Unsound to Sound Persons in the Total Offspring.

Descent.	I. Number of Families.	II. Number of Ruptured Males.	III. Number of Ruptured Females.	IV. Percentage of Male Ruptures.	V. Percentage of Females Ruptured.
With father ruptured . .	2,030	2,314	385	37.4	6.4
With mother ruptured . .	442	453	157	33.5	12.06
With both parents ruptured	158	211	69	42.6	14.1

Average family = 6.

Differences in the Influence of the Two Parents taken Singly or Together.—In Column II. of Table VI. the number of ruptured males with the father ruptured is a little more than five times the number with the mothers ruptured, which nearly corresponds with the proportion of males to females ruptured. The effect of the mother on the children of her own sex is seen in Column III., where the ruptured female children coming from the male ascendant are only 2.4 times as numerous as those from the female ascendant, though the proportion of male and female ruptured (parents) is still the same as in the previous case. These facts are more conveniently seen in Columns IV. and V., where the figures represent the percentage of ruptured persons amongst

the progeny sound and unsound. The male influence on the male offspring is seen to preponderate a little over the female influence, but the effect of the female on the female children is double that of the male. When hernia affects both parents, the proportion of ruptured children is seen to be higher in both sexes than in the case of either parent taken singly.

Referring again to Table VI., and using the figures in Columns II. and III., the varying ratio between ruptured males and females, according to the inheritance, can be found, thus :—

TABLE VII.

Descent.	Ratio of Males to Females Ruptured.
With father ruptured	6.01 : 1
With mother ruptured	2.8 : 1
With both parents ruptured . . .	3.1 : 1

The evidence thus far adduced makes no pretence of giving the true numerical result amongst the offspring of hernia in the ascendants; but its value consists in showing the differences of the effect, through differences of ratios, when one or other parent is ruptured. These differences are hardly susceptible of explanation except under the supposition that inheritance is an actual factor in the production of hernia.

In order to corroborate and to explain the above differences, and to elicit certain other facts concerning inheritance, another Table may be prepared. This Table is made up from those patients who were examined at the Truss Society during a certain period, and one or more of whose ascendants were ruptured.

TABLE VIII.

	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.
Descent.	Males.		Females.		Ratio of Males to Females.	Percentage of Males.		Percentage of Females.	
	Inguinal.	Femoral.	Inguinal.	Femoral.		Inguinal.	Femoral.	Inguinal.	Femoral.
Father ruptured . . .	3,454	100	358	208	6.2 : 1	97.2	2.8	63.3	36.7
Mother ruptured . . .	581	29	141	110	2.4 : 1	95.3	4.7	56.2	43.8
Both parents ruptured . .	170	6	39	22	3.3 : 1	96.6	3.4	57.6	42.3
Both parents ruptured (cases from records of twenty years)	508	24	80	50	3.1 : 1	95.5	4.5	47.1	52.9
Either grandfather ruptured .	574	3	93	24	4.9 : 1	99.5	.5	79.5	20.5
Either grandmother ruptured	90	2	35	10	2.04: 1	97.9	2.1	77.8	22.2

The results in Column V. of Table VIII. agree, so far as they admit of comparison, with those in Table VII. It would be expected that when

the grandfathers are ruptured, the proportion of males to females would be higher than 4.9 : 1 (Column V., Table VIII.). This apparent anomaly probably depends upon the influence of the maternal grandfather, that is, on the transmission by the female of male influence. If several hundred cases are taken with paternal and with maternal grandfather ruptured, the percentage of female grandchildren ruptured in the first series is 10.6 per cent., and in the second is 19.1 per cent.

If a comparison is made between inguinal and femoral cases (see Table VIII., Columns VI. and VII.), the mother's influence on the male is seen to increase the number of femoral herniæ, and the effect of the female in this respect can be traced even to the grandparent. The same influence appears to raise the percentage of femoral cases in women (Table VIII., Columns VIII. and IX.). When both parents are ruptured, and the cases are taken from the records of twenty years, the femorals actually outnumber the inguinals, and thus the ordinary relation of inguinal to femoral in women is reversed.

Influence of Grandparent determines Hernia in the Offspring early in Life.—The influence of the grandparent appears to favour the formation of inguinal hernia; but this probably is owing to the fact that persons deriving the affection from the grandparent are ruptured early in life. If all the male cases in Table VIII. (except those on line 4) are taken together, 21.7 per cent. are found to occur during the first year of life. If the cases with father, mother, and both parents ruptured are taken together, 15.1 per cent. of the offspring are ruptured in their first year; but among the cases derived from the grandparents, 61.6 per cent. occur in the first year.* It was held by Malgaigne, and by Kingdon after him, that "inherited tendency is stronger in infancy than in adult age." The statement is now seen to be true only so far as it concerns the cases derived from the grandparent. It is the grandchildren alone of ruptured persons that have a special tendency to early hernia.

Summary.—In this chapter an attempt has been made to show that inheritance is an agent, though, perhaps, a remote agent, in the production of hernia, and that the influence of the two sexes, when equal numbers of ascendants are taken, is nearly equal. It has also been explained that the slight differences in the influence of the two parents are caused by the fact that the male parent tends to increase the number of males ruptured when compared with the female parent; that the female ascendant not only considerably raises the proportion of ruptured

* The great disproportion in these percentages, which is also found in a somewhat lesser degree among the female cases, might be explained in part by supposing that persons ruptured late in life would forget that a grandparent had been ruptured. Few concern themselves to remember, or are curious to learn, the maladies of their grandparents, so that when a parent is free from the disease, its history will often be lost or forgotten.

among female children, but effects this chiefly by augmenting the number of femoral herniæ. She also tends to increase the number of femoral herniæ in males, and the influences in this respect on both sexes can be traced even to the grandparent. The combined influence of the two parents increases the proportion of ruptured children much above that due to each parent taken singly. The probable effect of the grandparent in causing the appearance of hernia early in life has been adverted to, and this effect is equivalent to an increase of the tendency to inguinal hernia. It has not, however, been possible to determine the actual proportion of the offspring which appears to be affected through inheritance, nor are there any facts whereby to form an estimate of the proportion of ruptured persons who have the faculty of transmission, if such exist.

CHAPTER V.

ON THE FORM OF THE ABDOMEN.

Alteration of the Form of the Abdomen in Ruptured Persons.—The contour of the abdomen is variously altered in ruptured persons, and with such frequency as to suggest that some relation subsists between these two conditions.

The normal form of the belly is somewhat barrel-shaped, with more or less flattening from before backwards. In infancy the rounded form is most conspicuous, but as growth proceeds and the pelvis enlarges, the anterior curve becomes flattened. Up to adult age the vaulting of the abdominal wall depends upon the volume of the contained organs. When life enters on its decline, the accumulation of fat in the mesenteries and omentum and in the subcutaneous tissue again increases the convexity.

Among a number of ruptured persons examined by Malgaigne, a large majority possessed a flat abdomen, and may be considered to have presented no peculiarity.[1] Among fifteen the abdomen displayed three prominences, "*ventre à triple saillée*," of which the middle corresponded in position to the linea alba and recti, and the lateral to the oblique and transverse muscles. (See Plate I.) The central bulging, which is due to yielding of the linea alba, is not often present; but the lateral bulgings are very common, and have been found by the author, in persons with inguinal or femoral hernia, to be seldom absent. They are seen at all periods of life from the earliest infancy to old age and reach their highest development in some cases of interstitial hernia.* It was this

* This bulging is placed by Velpeau in the class of ventral herniæ.

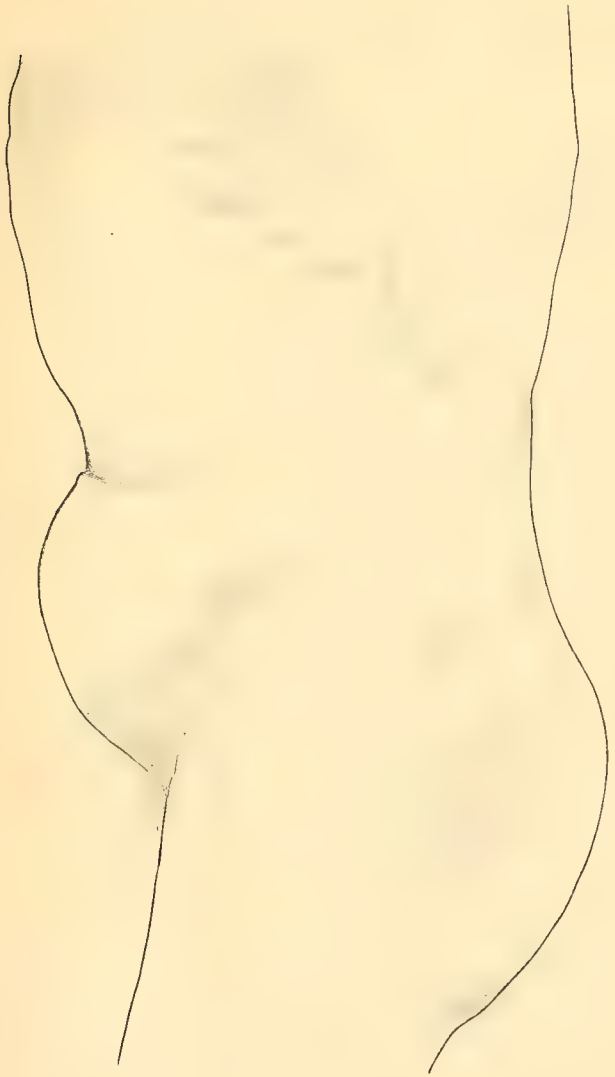
lateral bulging of the belly wall which was noticed by Monteggia, who observed that inguinal hernia is not usually limited by the abdominal rings, but extends upwards towards the iliac region, and forms an oblique prominence, which, when the patient coughs, descends like a wave towards the rings, and attains its greatest size in the inguinal region.[2] Malgaigne had the opportunity of examining a corpse in which the central and lateral bulgings were present. He found the linea alba had been stretched, as well as the aponeuroses of the oblique muscles external to the recti, but that the muscular masses had not suffered change.

The patient represented in Plate I. had incipient inguinal hernia on both sides. In him the lateral prominences were visible just when the abdominal muscles were set in action.

According to the observations of the author, this condition of the abdominal wall is not present or cannot be detected in persons inclining to corpulence. It is found in the majority of those with inguinal or femoral hernia, but loses much of its significance in this relation from its frequent occurrence in persons who are not ruptured. Its absence is usually noted in young healthy persons of good muscular tone. Though often observed in persons apparently sound, these lateral bulgings of the abdominal wall are never so prominent as in the ruptured. When hernia is on one side, the projection will be on both, but larger on the affected side. Looking to all these circumstances, this conformation must be regarded as antecedent to hernia, but not necessarily related to it, except so far as a lax condition of the abdominal wall contributes to an escape of the viscera.

Another and rarer configuration of the belly was observed by Mr. Kingdon and Dr. Wernher, and has more recently been noticed by Mr. Lockwood.[3] The anomaly consists in a flattening of the wall of the abdomen above the umbilicus, and a prominence below. This condition is rare, and several hundred abdomens were examined before it was discovered in the patient whose outline is given in Plate II. It appears to depend upon an habitual contraction of the transversalis abdominis above the crest of the ilium,[4] and is met with in elderly persons whose work has obliged them to keep a stooping position, such as gardeners and stone-breakers. It is thought by Mr. Lockwood to indicate prolapse of the mesentery. If that be the case, it would seem from the infrequency of this form of belly, and its absence in the majority of large herniæ, that prolapse of the mesentery is also rare, and rarely associated with hernia.

Here also, among the conditions which predispose to hernia, may be mentioned an undue width of pelvis, and a pelvis too strongly inclined. Jaeger considered these matters of much importance in the production of hernia. Though we are not in a position to deny their



influence, it is obviously difficult in the extreme to bring them into relation with hernia, and, so far as the author is aware, this relation has never been demonstrated.

REFERENCES TO CHAPTER V.

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2. **Monteggia.**—Fasc. Path. Tig., 1793, p. 82; quoted by Meckel, Handb. d. Path. Anat., ii. 410.
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CHAPTER VI.

CONDITIONS PREDISPOSING TO INGUINAL HERNIA IN THE MALE—ANOMALIES OF THE TESTIS.

The perforation of the abdominal wall by the testicle in its descent, suggested long ago that this event may be associated with the production of inguinal hernia. And inasmuch as this disturbance of the parietes takes place in the one sex, and not in the other, it may in part account for the greater frequency of inguinal hernia in the male sex. But it affords no explanation of the occurrence of hernia in one man rather than in another. One cause of this selection may be sought in the anomalies in the descent of the testis, and these may be most conveniently arranged in two groups.

Relation of Hernia to Anomalies in the Descent of the Testis.—To the first belong the cases in which the testis is arrested at some point short of its destination. In the second group are those cases in which the testis succeeds in reaching the bottom of the scrotum, but the retrogressive changes which follow that event are not completed, and the processus vaginalis remains, in part or altogether, in communication with the abdominal cavity. It is not uncommon to find these two sets of conditions together; for instance, a testis may be retained in the inguinal canal, and its tunica vaginalis may still be patent; or a testis in the scrotum, whose serous cavity communicates with the abdomen, may be itself small and undeveloped.

Arrest of the Transition of the Testis.—The first group consists of those cases in which the testis is retained in the abdominal cavity, or in the inguinal canal, and of those in which the organ has left the canal, but hangs close to the external inguinal ring, or high up in the scrotum.

Sometimes the anomaly is no more than imperfect size and development of the organ.

When arrested in its course to the scrotum, the testis is frequently[1] less than the normal size, and those retained within the abdomen were thought by Hunter[2] to be smaller than those that have descended lower down. Among 286 persons at the Truss Society whose testes occupied an unusual position, 275 (R. 138, L. 88, D. 49) varied in size from that of a pea to that of a filbert. In seven of the cases, though arrest had occurred, these glands had attained their full size. In four persons one testis was small and arrested, whilst the other was much larger than the normal, and had apparently undergone a compensatory hypertrophy.

Cases of arrest of development of the testis in relation to hernia may be most conveniently considered according as the testis is outside or within the external abdominal ring.

When the Testis is within the Ring, it is usually found in the canal, less often in the abdominal cavity. If the testis suffers inguinal inclusion, its serous cavity may or may not communicate with that of the peritoneum;* in some instances the processus vaginalis is closed, but during life it is seldom possible to determine the condition of the processus in this respect.†

During the years 1888, 1889, and 1890, 182 persons came to the Truss Society with inguinal or abdominal inclusion (Table IX.).‡ All were ruptured, and in 158 in whom one testis was affected, the protrusion first appeared on the same side as the anomaly in 141, in 13 on the side opposite to the anomaly, and in 4 on both sides at once. Among 211 such cases taken from former years (1884 to 1887), 180 had hernia first on the same side as the inclusion, and 31 on the opposite side. So that these numbers indicate that retention of the testis does not necessarily determine the side on which hernia shall appear, but that it generally does.

Whether hernia accompanies inclusion of the testis in the majority of cases cannot be ascertained, and great difficulty would be met in the inquiry, seeing that hernia may occur at any period of life in presence of this malformation. Wherefore the lists of these anomalies given by authors are apt to be misleading. Wrisberg[4] examined 102 infants in the first few weeks of life, and found some imperfection in the development of the testis in 30, but among the whole number only two were ruptured, and in those two the testis was in the scrotum. This

* MM. Goubeaux and Follin found the tunica vaginalis in the majority of cases closed to the abdomen in inguinal inclusion. Curling says it is usually open. Sachs finds it patent in 64 per cent.

† In cases in Table IX. the tunica vaginalis was found patent in 13 (R. 5, L. 6, D. 2).

‡ One patient, æt. twenty-five (not in Table IX.), whose right testis was retained, had a left femoral hernia that was noticed at the age of fourteen.

TABLE IX.

Cases of Inguinal Hernia seen at the Truss Society in 1888, 1889, 1890, *with Retention of one or both Testes in the Canal or Abdomen.*

		Total.	Under 1.	1–5	6–10	11–15	16–20	21–25	26–30	31–35	36–40	41–45	46–50	51–55	56–60	61–70
§ I. Cases entered according to the age at first appearance of the hernia	Right testis retained and inguin. hernia—															
	,, ,, ,, right .	97	33	17	10	15	10	1	5	4	1	...	...	...	...	1
	,, ,, ,, left .	1	...	...	...	...	...	...	...	...	1	...	..	...	...	...
	,, ,, ,, double	2	1	1	...	...	...	...	...	...	...	...	...	...	...	...
		100	34	18	10	15	10	1	5	4	2	...	...	...	...	1
Ditto according to age at visit	Right testis retained and inguin. hernia—															
	,, ,, ,, right .	84	4	6	12	24	13	4	5	6	5	3	1	...	..	1
	,, ,, ,, left .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	,, ,, ,, double	16	...	...	2	2	...	2	2	1	3	3	...	...	...	1
		100	4	6	14	26	13	6	7	7	8	6	1	...	...	2
§ II. Ditto according to age at first appearance	Left testis retained and inguin. hernia—															
	,, ,, ,, right .	12	2	2	1	2	2	...	..	1	1	1	.	...	...	...
	,, ,, ,, left .	44	14	3	4	9	4	4	4	1	1	...	...	...	..	..
	,, ,, ,, double	2	2	...	...	...	...	...	...	.	.	...	...	...	...	...
		58	18	5	5	11	6	4	4	2	2	1	...	..	...	...
Ditto according to age at visit	Left testis retained and inguin. hernia—															
	,, ,, ,, right .	5	...	1	2	...	...	...	..	1	...	1	...	...	...	...
	,, ,, ,, left .	40	1	2	3	8	4	6	..	4	7	2	1	.	1	1
	,, ,, ,, double	13	1	1	...	1	1	2	2	1	2	1	...	...	1	...
		58	2	4	5	9	5	8	2	6	9	4	1	..	2	1
§ III. Ditto according to age at first appearance	Both testes retained and inguin. hernia—															
	,, ,, ,, right .	13	7	...	1	2	1	...	1	...	...	...	...	...	...	1
	,, ,, ,, left .	4	2	...	1	1	...	..	...	...	...	...	...	..	..	...
	,, ,, ,, double	7	5	2	..	...	..	..	..	..	..	...	...	..	..	...
		24	14	2	2	3	1	...	1	..	...	...	...	...	...	1
Ditto according to age at visit	Both testes retained and inguin. hernia—															
	,, ,, ,, right .	5	1	1	..	1	.	...	...	1	...	...	1	...	...	...
	,, ,, ,, left .	2	.	..	1	1	.	..	...	...	...	...	...	..	..	...
	,, ,, ,, double	17	2	5	4	3	...	...	1	.	1	...	...	...	...	1
		24	3	6	5	5	..	...	1	1	1	...	1	...	...	1
§ IV. Ditto according to age at first appearance of hernia	Right testis retained and right hernia .	97	33	17	10	15	10	1	5	4	1	...	...	...	...	1
	Left ,, ,, left ,,	44	14	3	4	9	4	4	4	1	1	...	..	..	...	...
	Both testes ,, double ,,	7		2	..	..	...	..	...	...	...	...		...	...	...
		148	52	22	14	24	14	5	9	5	2	...	...	...	...	1

unexpected result is probably due to the examination having been made so early in life, for the hernia of children does not usually manifest itself till some weeks or months after birth.*

If the anomalies, now under consideration, influence the production of hernia, it is evident that, as they exist at birth, and may continue unchanged throughout life (Table IX.), they must act by causing herniæ to appear early in life in greater proportion than in those persons who are free from these imperfections. And this is found to be true, for if the cases under one year (Table IX.) are compared with the whole number, 35.1 per cent. occur in the first year of life. Moreover, Table IX. consists of those cases with the testis retained completely, or retained in the canal. Among 165, 70 had the testicle completely retained, and in 95 it was in the canal. In the first set the cases under one year amounted to 42.8 per cent., and in the second to 34.7 per cent.

In order to learn the full significance of these percentages, they must be compared with a percentage obtained from cases of hernia in which there has been no defect of development. If a number of scrotal herniæ are taken (see Table XIV., Part I.), it is possible to separate from them, not only those that have anomalies of the testis, but those also that are in the tunica vaginalis. The remainder consist of ordinary herniæ and some cases of hernia in the funicular portion of the tunica vaginalis, which are necessarily included, as they cannot be detected with certainty during life. Among the ordinary scrotal ruptures the percentage of cases occurring in the first year is 7.7 per cent., which is in striking contrast with the percentage (35.1 per cent.) in cases where the testis is retained. Therefore abdominal and inguinal inclusion have a distinct, and a very considerable effect in determining the early appearance of hernia; and the more complete the inclusion, the larger is the proportion of ruptures in early life.

Certain persons have one testis retained and the other arrested at some point outside the inguinal canal. A list of these cases for the years 1888, 1889, and 1890 is seen in Table X. If this Table is compared with § III. of Table IX., the two are found to correspond very nearly, both as regards the ratio of right hernia to left, and as to the percentage of cases occurring in the first year of life. For the cases in Table X. are probably those in which both testes were originally retained, and in which one has been pushed down by the descent of the hernia.

Testis arrested Outside the Canal.—On passing now to the cases in which the testis has been arrested outside the inguinal canal, in which the organ not only has failed to reach its usual position, but has failed also, as a rule, to reach its normal size, it must not be forgotten that,

* Zuckerkandl examined forty-three males with the testis in the canal, and none were ruptured (Arch. f. klin. Chir., 1876, vol. xx., 1st fasc. p. 215).

TABLE X.

Cases of Inguinal Hernia (1888, 1889, 1890) *in which one Testis was Retained and the other was Arrested at some point outside the Inguinal Canal. The Cases are entered according to the Age and Side affected at the first appearance of the Hernia, but the Anomalies are such as were observed at the time of the visit of the Patient.*

	Total.	Under 1.	1 5	6 10	11-15	16 20	21 25	26 30	31-35	36-40	41-45
Right testis retained and left arrested outside the canal with hernia—											
,, ,, ,, right .	2	1	.	1		...	. .	. .	...	...	. .
,, ,, ,, left .	4	. .	...	2	. .	. .	...	1	...	...	1
,, ,, ,, double .	1	1	..	...	...	...	...	...	...	..	
	7	2		3	...	. .	. .	1	...	...	1
Left testis retained and right arrested outside the canal with hernia—											
,, ,, ,, right .	14	8	2	.	2	1	1	.	...	...	...
,, ,, ,, left .	2	2	..	. .	...	...	...	...	...	...	...
,, ,, ,, double .	1	...	1	. .	...	...	. .	...	...	..	...
	17	10	3	.	2	1	1	..	.	...	...

though the state of the testis at the time of the patient's visit to the surgeon is known with certainty, yet the original position of the organ at birth is not known. During the previous years of life the anomaly has not been less in degree than it is at the time of examination, but it may have been of a higher degree, and the descent of the hernia may have altered the position of the testis. The rupture and the descent of the testis may coincide; or hernia may occur at an earlier period than the descent of the testis; or the testis, after arrest, may descend, and, later still, a hernia may make its appearance. The succession of these events has been observed in 79 persons. In 24 the hernia and the testis came down together; in 9 the testis, after being retained, descended, and, some years later, the hernia followed; and in 46 the hernia occurred some time before the testis descended; so that, in the majority of these cases, the rupture does not at the time of its first appearance produce locomotion of the testicle. Moreover, Table IX. shows how long the testis can preserve its position unchanged in the presence of a hernia, and therefore when cases of hernia with arrest of the testis outside the inguinal canal are tabulated, it is probable that the majority express the actual position of the testis at the time of the origin of the hernia, but that there must be a certain number in which the testis has changed its position since the hernia was first developed. With this reservation the Table (XI.) must be read, in which are set forth the herniæ accompanying anomalies of the testis, when the organ is outside the inguinal canal. The herniæ are arranged according to the age and the side at which they first appeared, but the anomalies are such as were observed at the time of the visit of the patient.

The results derived from this Table are of much the same character as those from Table IX. The herniæ under one year amount to 26.1 per cent. of the whole number, which shows that this class of anomaly tends to cause early hernia, but less decisively than abdominal or inguinal inclusion. The anomaly almost always determines the side on which the rupture first appeared, but the ratio of right hernia to left, 1.6 : 1, is less than it is when the testis is retained (Table IX., R. : L. = 2.2 : 1), but a little greater than it is among cases which are free from defect of development (Table XIV.).

Of the remaining anomalies of the testis which are found in conjunction with rupture, the principal are the deviation of the organ to the perinæum and to Scarpa's triangle.* Sometimes the testis is found

* A remarkable case of deviation of the testis, not accompanied by hernia, is described by Dr. W. Popow, in which the left testis was lodged at the root of the penis, where it had been drawn presumably by the inner branch of the gubernaculum. Dr. Popow calls this Ectopie testiculaire peno-pubienne anterieure. (Bull. Soc. Anat., 1888, p. 655.)

TABLE XI.

Cases of Inguinal Hernia (in the Years 1888, 1889, 1890) *accompanying Anomalies of the Testis when the Organ was outside the Inguinal Canal. The Herniæ are entered according to the Age and Side Ruptured at the first appearance of the Disease, but the position of the Testis was that observed at the visit of the Patient.*

	Total.	Under 1.	1–5	6–10	11–15	16–20	21–25	26–30	31–35	36–40	41–45	46–50	51–55	56–60	61–65
Anomaly of the right testis and inguinal hernia—															
,, ,, ,, right .	122	32	5	7	14	23	18	7	6	2	4	2	1	...	1
,, ,, ,, left .	4	1	...	...	...	2	...	1	...	...	...	...	...	...	...
,, ,, ,, double	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...
	127	34	5	7	14	25	18	8	6	2	4	2	1	...	1
Anomaly of the left testis and inguinal hernia—															
,, ,, ,, right .	2	1	...	...	1	...	...	...	...	...	...	...	...	...	...
,, ,, ,, left .	74	18	7	6	10	4	7	7	7	2	6	...	...	...	...
,, ,, ,, double	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...
	77	20	7	6	11	4	7	7	7	2	6	...	...	...	...
Anomaly of both testes and inguinal hernia—															
,, ,, ,, right .	30	5	2	...	2	2	6	7	3	...	...	2	1	...	...
,, ,, ,, left .	13	2	1	...	1	2	2	3	...	...	1	1	...	...	...
,, ,, ,, double	3	2	...	1	...	...	...	...	...	...	...	...	...	...	...
	46	9	3	1	3	4	8	10	3	...	1	3	1	...	...

near the anterior superior iliac spine, or elsewhere on the abdominal wall in interstitial hernia, but this displacement may be more appropriately considered when that form of hernia is described. The numerous instances (Table XI.) in which the testis is arrested below the external inguinal ring, and is usually less than the normal size, must be distinguished from that rarer variety,* in which the testis passes the scrotum and stops short on its way to the perinæum.† In these cases also the scrotum on the affected side is generally empty and flat; the testis is small, and, with the hernia that sometimes accompanies it, is covered by the smooth skin of the part, which forms a pocket external to and distinct from the scrotum.‡ The attendant herniæ are often in the tunica vaginalis, and the testis can be moved upwards, but cannot be drawn down.

Throughout this inquiry into the relation between hernia and arrested development of the testis, it has not been possible to discover in what proportion hernia is present among the different anomalies, and the same difficulty is met with once more in the case of the testis lodged in the perinæum. Hernia is seldom found in conjunction with perinæal ectopia in the lists given by authors;[8] but among the persons thus affected who have visited the Truss Society, rupture was of course its usual accompaniment. Two cases only out of twenty-four were free from rupture.

Hernia with Perinæal Ectopia.—The twenty-two cases with hernia have been arranged in Table XII., which shows, what has already been seen in respect of the other displacements of the testis, that a person with this anomaly is not most commonly ruptured in infancy. In some cases (four) the testis did not reach the perinæum till the hernia came down. Another case (not given in Table XII.) may here be mentioned, in which a hernia descended to the perinæum, leaving the testis completely retained in the abdomen.§ The testis was noted to be of full

* Termed by Englisch "Ectopia scroto-femoralis."[7]

† The gubernaculum testis, one of those transitory structures which play an important part in fœtal life, can be traced in three directions after it emerges from the external inguinal ring. One part turns inwards over the pubes, a second turns outwards and is lost over the upper part of Scarpa's triangle, whilst the middle fibres descend to the scrotum. From those going to the scrotum a portion branches off sometimes and proceeds backwards to the perinæum, even as far as the ischial tuberosity.[5] This last portion, which, like the rest of the gubernaculum, is partly composed of smooth muscular fibres, has by some been considered instrumental in directing or dragging the testis to the perinæum.[6]

‡ These remarks are based on twelve cases (L. 8, R. 4) seen at different times.

§ This case seems to belong to the same category as that of a boy, æt. 16, who died at the Lariboisière, and was dissected by Godard. In the scrotum were two hernial sacs, the processus vaginales of testes, which were retained 15 millimetres above the internal inguinal rings.[9] Several such cases have been observed by the author.

TABLE XII.

Cases of Inguinal Herniæ with Testis in the Perinæum, from the Records of Twenty-five Years, arranged according to the Age and Side affected at the first appearance of the Hernia.

	Total.	Under 1.	1-5	6-10	11-15	16-20	21-25	26-30	31-35	36-40	41-45	46-50
Right testis in perinæum with right hernia . . .	13	5	...	...	2	1	1	1	2	...	1	...
Left ,, ,, ,, left ,, ...	7	...	...	...	...	...	2	1	2	1	...	1
,, ,, ,, ,, double ,, ...	2	2	...	...	...	...	...	...	...	...	...	...
	22	7	...	...	2	1	3	2	4	1	1	1

TABLE XIII.

Cases of Inguinal Herniæ with Testis in Scarpa's Right Triangle, from Records of Twenty-five Years, arranged according to the Age and Side affected at the first appearance of the Hernia.

	Total.	Under 1.	1-5	6-10	11-15	16-20	21-25	26-30	31-35	36-40
Right testis in Scarpa's triangle with inguinal hernia—										
,, ,, ,, ,, right	15	7	...	...	2	2	2	1	1	...
,, ,, ,, ,, left	1	...	...	...	...	1	...	...	...	...
	16	7	...	...	2	3	2	1	1	...

size in one patient, and very small in eight; whilst in ten cases the hernia was in the tunica vaginalis.

Looking to the occasional existence of a band proceeding from the gubernaculum to the perinæum, it might be anticipated that the movement of the testis upwards would be limited. But no difficulty was usually found in pushing the organ upwards, and in four cases it could be returned with the hernia into the abdomen, so that the perinæal band was either absent or was no longer efficacious in keeping the testis in position.

Ectopia Cruralis.—When the testicle is situated in the upper part of the thigh, it commonly descends the inguinal canal, and, after passing the external ring, turns outwards to the groin. Sometimes in interstitial hernia the protrusion becomes so prominent, that it falls over the front of the thigh, and the testicle, which is within the sac, seems to be lying over Scarpa's triangle. A few such cases are found in surgical records, and an illustration of one may be seen in Plate IX., which shows the position of the hernia, but not that of the gland after reduction of the hernia. These are not genuine cases of Ectopia cruralis, and need not be further considered here.

During the last twenty-five years, sixteen cases of Ectopia cruralis have been seen at the Truss Society (Table XIII.). All the misplaced testes were in Scarpa's right triangle, and all the herniæ were inguinal on the same side, except one, which first appeared on the left side and afterwards became double. The usual position of the testis is seen in Plate III., which gives a representation of the parts in a South African, æt. 29. He had had a rupture on the same side from infancy. The testis lay near the upper and inner sides of Scarpa's triangle over the femoral artery, 1½ to 2 inches below Poupart's ligament. The gland, which was about the size of a filbert, was freely movable upwards, and its cord could be traced to the external inguinal ring. The right half of the scrotum was not developed. The testis has not always the oblique position shown in the figure, but at times lies transversely. In all the cases in Table XIII., and in those described by authors,[10] the testis appears to have been below the normal size. In two persons the testis was retained till the hernia came down at the ages of eighteen and nineteen respectively.

It has long been believed that the testis occasionally comes down to the thigh by the femoral canal, and at least eight cases are recorded in which this event is supposed to have happened.[11] That a femoral hernia may bring down with it a testicle previously retained is not impossible, but that the testis ever descends primarily and independently along the femoral canal is so doubtful as to require strict proof.

Among the eight cases to which references are given, six were

examined during life, and the testis in each was found in Scarpa's triangle; but there is not sufficient evidence that it came there by the crural canal, or in one case that it was the testicle at all. Eckardt's dissection is so imperfectly described as to be quite untrustworthy. Mr. Curling's case also was dissected, but even in this the details are meagre, and no mention is made of the course taken by the spermatic cord towards the abdomen. Something more, therefore, is needed to justify this long cherished belief.

In regard to the frequency of the occurrence among inguinal herniæ of the different anomalies of the testis, taken together, it is found that it amounts to 2.6 per cent.* Thus the influence of those defects in producing hernia is exercised over a very small number of persons subject to the disease. Within these narrow limits, the result of the anomalies has shown itself in the occurrence of hernia in infancy with greater frequency than in ordinary cases. And the more complete the arrest of development, the larger is the proportion of ruptures in early life. In like manner, the ratio of right hernia to left is greater in each group than in ordinary cases, and the ratio is higher the more complete the arrest of development. It has also been seen that the hernia, at whatever age occurring, generally, though not invariably, appears first on the same side as the anomaly.

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   Godard.—Rech. Teratolog., &c., 1860, p. 58. Plate VIII.
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* In 1888, 1889, and 1890 the total number of male inguinal herniæ seen at the Truss Society was 17,538, and the total number of persons with anomalies of the testis was 468.

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CHAPTER VII.

HERNIA IN RELATION TO ANOMALIES OF THE PROCESSUS VAGINALIS.

Incomplete Closure of Processus Vaginalis.—When the testis has completed its descent in the normal course of development, the processus vaginalis at once begins to undergo those changes which effect the closure and obliteration of its canal. Sometimes this "regressive metamorphosis," as Schreger termed it, fails to occur, or is carried out so imperfectly that the abdomen remains in communication with the whole or with a part of the processus, which may thus become a receptacle for some of the viscera. If the canal continues altogether open, the protrusion forms the "hernia tunicæ vaginalis" of Astley Cooper. If a part only of the canal is patent, the hernia is said to be in the funicular portion of the tunica vaginalis, "hernie vaginale funiculaire" of Malgaigne.

Early Observations of Hernia in the Tunica Vaginalis.—Before the discovery made by Haller and Hunter of the descent of the testis, and the consequent explanation of hernia in the tunica vaginalis, these ruptures had often been observed and described. It was supposed, when a hernia descended and its sac came in contact with the tunica vaginalis, that sometimes the two serous layers became adherent, and were perforated either by rupture or ulceration, and that thus the bowel entered the same cavity with the testicle. Cases of patency of the tunica vaginalis were recognised in a few instances before Haller. Thus H. Baseus in 1596 saw a boy castrated for the cure of hernia, and found the tunica vaginalis open up to the abdomen.[1]

In Stephen Blancard's description of the peritoneum he notices a single process for each groin which is closed in males as well as in females, but is open in dogs and other brutes. "Once I saw this open in a man on the left side; whether in youth he laboured under hernia is uncertain. . . ."[2]

And again Mery, in 1701, whilst discussing a case of scrotal hernia with omentum adherent to the testis and spermatic vessels, makes the following observations:—"This is difficult to explain, for, as in the herniæ which happen by the weight of the intestines and epiploon, and by relaxation of the mesentery and of the peritoneum, the peritoneum forms generally a cul de sac, in which are contained the parts which pass beyond the rings of the abdominal muscles; it is not easy to understand how the epiploon has been able to unite itself with the spermatic vessels, and to the testis enclosed in its own membranes. If we suppose the peritoneum broken by some effort, and that by the opening the omentum should have been able to descend into the scrotum, one cannot explain by rupture of the peritoneum that of the membranes proper to the testicle, without which it is impossible to conceive the union of the omentum and testicle. Now, as these membranes have been found sound and entire, we cannot explain this extraordinary union but by supposing that there is a natural sheath of peritoneum, like that met with in the males of several species of animals that I have dissected. This naturally hollow sheath communicates with the cavity of the belly; it extends from the ilia to the bottom of the scrotum, and encloses the testis, with the spermatic vessels which are attached to its inner surface, by a very delicate membrane about two lines wide, and of the length of the sheath itself. If we suppose this in the subject in question, it is easy to imagine that the epiploon, having descended into this sheath, has been easily able to unite with the seminal vessels and testis by the long sojourn it has made in the cavity."[3] After this admirable exposition of the subject, it is astonishing to find such men as Sharpe and Cheselden reverting to the old error.

Patency of the Processus without Hernia.—At the end of the seventeenth and beginning of the eighteenth centuries it was generally recognised that the tunica vaginalis was closed in man. But when the development of the testis came to be studied, it was soon discovered, not only that the tunica vaginalis may remain open and receive the intestine, but that it may remain open without giving place to a hernia.[4]

This was observed by several writers at the end of the last century, and at length it was suggested, that the immunity from hernia in such cases was due to the presence of a fold, which partly screens the abdominal opening of the processus vaginalis, when this remains unclosed. It was called by Meckel "ligamentum transversale internum," and Sandifort supposed that when it is deficient there is no obstacle to the descent of the viscera.[5] This fold, which is usually formed of peritoneum and the edge of the infundibuliform fascia, has been given by later writers various degrees of importance. If it has any office in relation to hernia, its effect, unfortunately, is not susceptible of proof.

Relation of the Herniæ of Childhood to the Processus Vaginalis.—Giraldés, who dissected a large number of herniæ in children, found the sac distinct from the tunica vaginalis; and Morel Lavallée dissected thirty herniæ in infants, and only twice found the testis in the sac.[6] But several authors of eminence have regarded all oblique inguinal herniæ in childhood as occupying some part of the processus vaginalis.[7] If this were so, all the oblique herniæ of children should give evidence of a pre-formed sac. But in many cases it is very difficult to obtain assurance of the congenital origin of the sac. In the observations made by Sachs on the relation of the vas deferens and spermatic vessels to the posterior wall of the processus vaginalis, so much variation was found in the position of these structures that they could not be used as a test for hernia in the funicular portion. But, by making microscopical sections of spermatic cords, Sachs found that the structure called "internal cremaster," by Henle and Kölliker, which is composed of smooth muscular fibres arranged in bundles, and is part of the smooth muscle of the cord, is always placed against the hinder and lateral wall of the processus vaginalis. He concluded, therefore, that if this internal cremaster is found at the back of a hernial sac, it shows that the sac is derived from the processus vaginalis. Sachs has not been able to trace the muscular bundles in the inguinal canal, but only in connection with that part of the processus which is below the external ring. In the adult a hernia is placed in front of the cord, and behind the external cremaster. The constituents of the cord, and among them the internal cremaster, are often separated and closely applied to the posterior wall of the sac. It is difficult to understand, then, how its presence can be distinctive of hernia in a part of the processus vaginalis.

The relative frequency in the dead body of patency of the tunica vaginalis has occupied the attention of many surgeons, for it was expected to throw light on the connection between this condition and hernia. The results of their observations can only be stated generally, for there is no close agreement amongst them, and for this reason, as well as that their inspections were principally of the bodies of young children, no very reliable estimate can be formed of the proportion of persons who have the processus vaginalis wholly or partly open.

At birth the serous canal is very often open on one or both sides, either totally or partially. At first it tends to close very rapidly, but after the third week more slowly. In adult life, patency of the canal, which may be met with up to an advanced age, though not uncommon, is far rarer than in childhood, and the calibre of the passage seems to be usually very narrow.[8]

The size of the opening is, as a rule, larger on the right side than on the left, and oftentimes the size is greater in older than in younger

children; and this last fact implies that the tendency to obliteration may remain in abeyance, and that the growth of the canal may keep pace with the growth of the child. This observation is of some consequence, for it assists to explain the abundant production of ruptures as the age of puberty is reached.

Though complete or partial patency of the processus vaginalis is regarded as an important predisposing cause of ruptures, at all events of those in early life, there can be little doubt, if the evidence from the examination of the dead be received, that hernia enters this passage in a minority of the instances in which it remains open. If an unclosed canal was invariably attended with rupture, the number of ruptures, as Engel remarked, would be very much greater than it is.

The frequency of the occurrence of Hernia in the Tunica Vaginalis may be estimated from observation of cases during life. It is easy to detect this condition when the hernia is scrotal, by attending to the relation of the testicle to the protrusion; and, though Féré denies the possibility of making the diagnosis, it presents no more difficulty than a case of congenital hydrocele.

Not all herniæ in the tunica vaginalis are scrotal at the time of examination, but by taking a large number of scrotal herniæ, that is, of protrusions under the same conditions, the relation of hernia in the tunica vaginalis to ordinary hernia can be calculated with fair accuracy (Table XIV.). It is found that among 3175 scrotal herniæ about 8 per cent. (7.7 per cent.) are in the tunica vaginalis, and as there is no essential difference between inguinal herniæ in general and scrotal, it is not unfair to extend this conclusion, and regard 8 per cent. of inguinal herniæ as in the tunica vaginalis.

The partial patency of the processus happens somewhat more often than the complete patency,* but the relative frequency of the two conditions cannot be accurately determined from the lists of the authors above referred to. If, therefore, hernia of the funicular portion has the same relation to patency of that portion of the canal, which hernia of the tunica vaginalis has to patency of the whole canal, the herniæ of the first kind will be a little more numerous than herniæ of the second kind. Therefore, if hernia of the tunica vaginalis amount to 8 per cent., herniæ of the funicular portion may amount to about 10 per cent., and both together will form a little under 20 per cent. of inguinal herniæ. Thus it is probable that the large majority of inguinal herniæ are ordinary herniæ, and are not associated with failure in the obliteration of the processus vaginalis.

The scrotal herniæ that were seen at the Truss Society in 1888, 1889,

* From the lists of Camper, Féré, and Sachs, partial patency is to complete patency as 1.3 : 1; but Ramonède's observations give 15 : 1.[9]

and 1890, are arranged in Table XIV. in four sections, according as the testis was normal or abnormal, and as the tunica vaginalis was open or closed.

The Table comprises those persons with scrotal rupture who visited the Truss Society in the above years. They are entered under the age and side ruptured at the first appearance of the hernia. §§ I. and III. include the cases with normal testis. § I. contains the ordinary scrotal, § III. the herniæ in the tunica vaginalis. §§ II. and IV. include the cases with the testis ill-developed, or not fully descended. In § IV. the herniæ were in the tunica vaginalis. All the cases in Table XIV. have appeared before in Table I., and those in §§ II. and IV. in Tables IX., X., XI.

From the ordinary scrotal it was, of course, impossible to separate those in the funicular portion, for that condition cannot be accurately determined during life, and, even with the most experienced surgeons, their diagnosis will be little better than a guess.

The group of herniæ in the tunica vaginalis, which had at the same time a misplaced or ill-developed testis, might be expected to show most conspicuously a tendency to early appearance, but this it does not, for in these cases the number under one year is 24.2 per cent., whilst in hernia of the tunica vaginalis with normal testis it is 28.8 per cent. This apparent contradiction probably arises from the small number of cases available for examination. The differences among these four groups in their liability to hernia early in life is best seen by comparing the cases up to twenty years of age with each total.

Then—

In ordinary scrotal, together with scrotal in the funicular portion, 27.6 per cent. are under 20, and 7.7 per cent. under 1.

In scrotal with misplaced or ill-developed testis, 43.4 per cent. are under 20, and 23.9 per. cent. under 1.

In scrotal in the tunica vaginalis of normal testis, 71.1 per cent. are under 20, and 28.8 per cent. under 1.

In scrotal in the tunica vaginalis of a misplaced or ill-developed testis, 63.4 per cent. are under 20, and 24.2 per cent. under 1.

So that a patent tunica vaginalis (§ III.) appears to dispose more powerfully to early hernia than abnormality of the testis (§ II.) when that organ is outside the external ring. If the ratio of right hernia to left in the four sections of Table XIV. is examined, it is seen that the higher the degree of the anomaly, the higher the ratio of right to left.

From Table XIV.,	§ I.	Right Hernia :	Left	=	1.50 : 1.
,, ,,	§ II.	,,	,,	=	1.55 : 1.
,, ,,	§ III.	,,	,,	=	1.6 : 1.
,, ,,	§ IV.	,,	,,	=	2. : 1.

TABLE XIV.

Table of Scrotal Herniæ, arranged according to the Age of the Patient and Side affected, when the Hernia first appeared, from Cases seen in 1888, 1889, 1890 *at the Truss Society.*

Ordinary Scrotal Herniæ, with Testis normal.

	Under 1.	1–5	6–10	11–15	16–20	21–25	26–30	31–35	36–40	41–45	46–50	51–55	56–60	61–65	66–70	71–75	76–80	81–	Total.
§ I. Hernia—Right .	140	37	34	106	191	244	176	173	137	141	115	83	66	43	18	4	7	...	1,715
,, Left .	72	8	28	41	122	148	153	132	88	99	90	53	42	31	18	12	4	1	1,142
,, Double	11	2	...	1	2	2	3	2	...	...	1	...	1	..	...	...	...	...	25
	223	47	62	148	315	394	332	307	225	240	206	136	109	74	36	16	11	1	2,882

Scrotal Herniæ, with Testis misplaced or ill-developed.

§ II. Hernia—Right .	9	...	...	2	1	4	3	4	...	1	2	1	...	1	...	...	...	...	28
,, Left .	2	1	...	2	3	1	4	4	1	...	...	...	...	...	...	...	...	...	18
,, Double	...	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...	...	...	...
	11	1	...	4	4	5	7	8	1	1	2	1	...	1	...	...	...	...	46

Scrotal Herniæ in the Tunica Vaginalis Testis, with Testis normal.

§ III. Hernia—Right .	26	7	6	6	15	8	8	4	4	2	...	1	...	...	1	...	...	...	88
,, Left .	15	3	3	4	17	2	4	1	3	1	1	1	...	...	...	...	...	...	55
,, Double	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	41	10	9	10	32	10	12	5	7	3	1	2	...	...	1	...	...	...	143

Scrotal Herniæ in the Tunica Vaginalis, with Testis misplaced or ill-developed.

§ IV. Hernia—Right .	17	2	5	8	14	8	2	5	4	3	...	1	...	...	...	...	...	...	69
,, Left .	8	1	3	6	3	4	5	2	1	1	1	...	...	...	...	...	...	...	35
,, Double	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	25	3	8	14	17	12	7	7	5	4	1	1	...	...	...	...	...	...	104

Among the scrotal herniæ in Table XIV., § I., which comprise those in the funicular portion of the tunica vaginalis, a very small proportion occur early in life, whence it is evident, either that the herniæ of the funicular portion are in such small numbers as not to affect the proportion, or that partial patency of the canal does not strongly dispose to early hernia.

The facts and inferences above given do not go to support the opinion that patency of the tunica vaginalis, either partial or total, is essential to the production of hernia in childhood. It has appeared, however, that these conditions are frequently associated with hernia in early life, and occasionally in adult age, and that they are undoubtedly of high importance in disposing to inguinal herniæ in children.[10]

Two theories may here be referred to by which Wrisberg sought to account for the production of hernia in the tunica vaginalis.[11]

According to the first, the intestine or omentum may adhere, during fœtal life, to the testis, and the descent of the testis may determine the descent of the viscera. This notion has obtained some celebrity, and has received support from the observations made by Simpson on the frequency of fœtal peritonitis.

The second theory is founded on the fact that the peritoneal fold, which encloses the spermatic vessels in embryonic life, sends a short duplicature to the nearest part of the cæcum or end of the ilium on the right side, and to the sigmoid flexure on the left, and Wrisberg supposed that sometimes the testis drew down with it one or other of these viscera.*

This last theory has been considerably modified by Mr. Lockwood, its latest exponent; and, as it leaves his hands, affords the only adequate explanation of congenital hernia of the cæcum and sigmoid flexure.

It is only the herniæ which are formed in either of these ways that can truly be called congenital. Except in such rare cases, hernia does not appear till some days after birth.[12] Malgaigne tells us that Chaussier examined 23,292 new-born children at the Maternité from 1807 to 1812, and found among them only one ruptured at birth. Giraldés appears to have examined several thousand infants at the Foundling Hospital in Paris, and saw very few with hernia at birth.[13] The author's experience fully corroborates these observations.

* Lobstein described the peritoneal folds connecting the testis and cæcum on one side, and the testis and sigmoid flexure on the other (Diss. de Her. Cong., pp. 11, 17, note *d*, quoted by Wrisberg).

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CHAPTER VIII.

CONDITIONS PREDISPOSING TO INGUINAL HERNIA IN THE FEMALE—HERNIA IN THE CANAL OF NUCK.

The Process of Peritoneum, which accompanies the round ligament, exists in the female fœtus during a great part of intra-uterine life, but the dates of its origin and of its disappearance are not accurately known. The canal is generally found obliterated at birth, but it may remain open even into advanced life, and has been considered by Nuck[1] and by many since his time as a predisposing cause of hernia.* Little more can be said now than was said in the first instance by Nuck, when he

* Le Cat found this duct of the thickness of a goose-quill in a woman, who died æt. forty-six. "Its extremity was widened into the shape of a bubble as big as the top of a finger, and full of watery humour" (Philosoph. Trans., 1753, vol. xlvii. p. 328).

pointed out that this canal is sometimes occupied by part of the viscera; for congenital hernia, as Féré truly observes,[2] has been studied almost exclusively in the male, and its origin in females has received comparatively little attention.

Those who have met with the canal of Nuck have not usually found intestine within it;[3] but, resting on its analogy to the processus vaginalis in the male, they have surmised that it acts as a predisposing cause of hernia in the female. Its presence in the cadaver is exceptional, and is rarer in adults than in children. It is probable that it occurs somewhat less often than in 14.7 per cent. of bodies of all ages. If the estimates of different observers are taken together the result is 14.7 per cent., but this is too large a percentage, because the anomaly was looked for chiefly among children.[4]

The frequency of its occurrence according to the age may be judged of by comparing the statements of different authorities, thus—

		In the new-born	Camper	found the canal open in	21.4	per cent.*
In those from 0–335 days			Sachs	„ „ „	16	„
„ „ 1 365 „			Féré	„ „ „	15.5	„
„ „ 1 day to 13 years			Féré	„ „ „	10.9	„
In bodies of various ages			Wrisberg	„ „ „	9.5	„

So that, according to these pathologists, the later the age, the less often is the canal of Nuck patent. If, therefore, the presence of the canal is of moment in the production of rupture, it is evident that this influence wanes rapidly with the growth of the individual.

Though there are no means of discovering in what proportion of cases the patent canal becomes the receptacle for a hernia, some idea of it may be obtained from a consideration of cases of hernia of the ovary. When the ovary is external to the abdomen, the canal of Nuck is generally patent; and in a future chapter it will be shown that bowel accompanies hernia of the ovary in about half the cases.† When, therefore, the canal is patent, and no other anomaly is present, the proportion of cases in which it receives a hernia should be less than one-half.

The rarity of hernia in the canal of Nuck has been explained partly by the narrowness of that passage, and partly by the large size of the fold, already referred to as existing in the male, which protects the internal opening. The diameter of the entrance of the canal varies from 2 to 7 mm.,[5] and is generally less than that of the processus vaginalis, whilst the orifice is concealed by a fold, more distinct than that in the male, which completely covers the entrance to the canal.

* Camper examined 14 bodies; Sachs, 150; Féré, 109 under 1 year, and 158 from 1 to 13 years; Wrisberg, 200.

† See Chapter on Hernia of the Ovary.

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5. **Sachs.**—Op. cit., p. 341, 354.

CHAPTER IX.

THE RELATION OF HERNIA TO ANOMALIES OF THE INGUINAL CANAL. CONDITIONS PREDISPOSING TO FEMORAL HERNIA.

THERE are other local circumstances, in addition to those already mentioned, which affect in some measure the production of inguinal hernia, and these may be here pointed out. The difference in the frequency of this hernia in males and females has been partly accounted for by the rarer occurrence in the latter of defects in the development of the parts concerned in generation, and the cause may further be sought in the differences between the inguinal canals of the two sexes. This canal in the female, as it contains only the round ligament, is not so wide as that in the male, and it is of greater length on account of the greater distance between the spines of the ilium and the pubes. Thus the valvular structure of the canal, which is adapted to prevent the descent of the viscera, is more perfect in the female.

Condition of the Canal at Birth.—In the new-born the internal abdominal ring lies almost immediately behind the external ring, and the length of the canal is no more than the thickness of the abdominal wall.*[1] The direction of the canal is, therefore, from behind forwards. This disposition of parts in infancy favours the production of inguinal hernia, which then attains its greatest frequency.

Changes in the Canal with Growth.—As growth proceeds, the ilia

* Allan Burns says, "I have never observed the cord in any obvious degree oblique in its course in an infant at birth; it runs in a straight line from the psoas muscle to the bottom of the scrotum. It passes through a mere aperture."

incline outwards, and the internal ring follows this movement, whilst the posterior wall of the canal is built up by the progressive development of the conjoined tendon of the internal oblique and transversalis muscles, and of the transversalis fascia. During the lengthening of the canal it acquires at the same time its oblique direction.* The restoration of the abdominal parietes by the formation of the posterior wall of the canal cannot take place till after the testis has completed its descent, and may be considered as part of that "regressive metamorphosis" which effects the closure of the peritoneal cavity. The obliteration of the processus vaginalis is often imperfectly carried out, and, in like manner, deficiencies frequently occur in that constructive process whereby the hinder wall of the inguinal canal is formed.[2] That the inner wall of the canal is the seat of the imperfection that disposes to inguinal hernia is also probable from what is often witnessed during the formation of a protrusion. The anterior wall and external ring are at first apparently perfect, and only by gradual and slow degrees yield to dilatation. Though many authorities are agreed that the fault is in the posterior wall, there is some difference of opinion as to the actual structure that is principally subject to defect.[3]

Cloquet satisfied himself that variations occur in the strength of the peritoneum of the groins, and variations, probably of less importance, were observed in the size of the internal inguinal ring.

An enlargement of the testis, either from hydrocele or new growth, has been thought to favour the descent of inguinal hernia by the dragging of the spermatic cord on the inner ring and peritoneum.

Conditions Predisposing to Femoral Hernia.

Uncertainty as to the Predisposing Cause of Femoral Hernia.—If there is little certainty in regard to the predisposing causes of inguinal, there is still less in regard to those of femoral hernia: and on this account perhaps, almost all writers occupy themselves with the circumstances which produce the difference in the frequency of femoral in the two sexes, rather than with the cause of its incidence.

The Variations in the Structure of Gimbernat's Ligament appear to influence in the most important manner the occurrence of femoral hernia.[4] This ligament, which contributes to fill up the gap through which the hernia descends, and partly determines the size of that aperture, differs in width and strength in persons of the same sex; and in females it is sometimes represented merely by a slender lamella, or is almost altogether absent. The femoral ring may be of wide extent

* The formation of the posterior wall of the canal is admirably described by Allan Burns at p. 448 *et seq.* of Monro's work.

even where rupture is not present, as is well exemplified in a case described by Chaput.[5] The patient was about fifty years of age, and had a large right crural hernia, whilst on her left side was no hernia, but a femoral ring which was four centimetres across. In infancy and childhood the crural ring can scarcely be said to exist, and its calibre remains very small till the pelvis enlarges at the age of puberty. The rarity of femoral hernia in early life is thus accounted for, and the few cases that are met with, must necessarily be due to the existence of a femoral ring, that is originally and precociously large.

After the parts have attained their full and normal development, the occurrence of hernia seems due to the enlargement of the ring by stretching or by withdrawal of some of the tissues which close it. Sir Astley Cooper was of opinion that femoral hernia is especially the effect of gradual pressure and extension. The absorption of fat and connective tissue may give a wider compass to the ring, and favour the escape of a protrusion. Rapid thinning has long been a favourite cause of hernia with authors, and appears to be particularly applicable to the present variety. It is to this, perhaps, that the ruptures, which so frequently come down after an illness, owe their origin.

It has been asserted that femoral hernia is found in men who possess a pelvis of the female type, but a somewhat extensive clinical experience does not enable the author to corroborate this statement.

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C. Emmert.—Lehrb. d. Spec. Chir., 1871, ii. 150.
2. **Allan Burns.**—Op. cit., p. 455.
Astley Cooper.—On Hernia, 1804, p. 18.
Cloquet.—Rech. Anat., &c., 1817, p. 23.
J. v. Balassa.—Unterleibs. Hernien, 1856, p. 21.
3. **J. Wood.**—On Ruptures, 1863, p. 30.
4. **Cruvelhier.**—Anat., 4th ed., 1862, p. 536.
Cloquet.—Op. cit., p. 60.
Hyrtl.—Op. cit., p. 314.
5. **Chaput.**—Bull. Soc. Anat., 1887, p. 10.

CHAPTER X.

ON THE EXCITING CAUSES OF HERNIA.

The exciting causes of rupture are, by general consent, whatever lessens the capacity of the abdominal cavity and thereby increases the intra-abdominal pressure. Some cases are related of persons who have discovered a hernia during long confinement to a sick-bed. The well-known instance of a man who lay ill for a year with malignant disease of the kidney, and who became the subject of a double hernia, has been cited to show that an increase in the contents of the abdomen may give rise to a hernia.[1] Ascites, in like manner, may cause a protrusion; but the more usual mode, whereby the capacity of the cavity is diminished, is by contraction of the abdominal muscles. It is needless to enumerate the various acts which are attended by these contractions. The subject may be more fitly treated by considering the effect on the male of occupation and on the female of parturition.

The Effect of Occupation on the Male.—No attempt to gauge precisely the influence of occupation on the production of ruptures was made, till Malgaigne divided his patients into those who work standing and those who work sitting.[2] He found the proportion of the ruptured standing to the ruptured sitting to be 3 : 1. This division of labouring men is in several ways objectionable. Almost all handicrafts are exercised standing; many allow the men sometimes to stand, sometimes to sit; others employ a part standing and a part sitting; and the few trades that permit of sitting attract, as a rule, small numbers of operatives.

To ascertain the effect of occupation, it is necessary to select those trades, whether exercised standing or sitting, which engage large numbers of men, and those which give to all the members of the same calling the same kind of work. A Table formed, as nearly as may be, on these lines is here given (Table XV.) In the first column the names of the occupations are so arranged that the larger the number of persons engaged in a trade, the higher on the list is the name of that trade. In the second column is given the number of ruptured persons, between the ages of twenty-one and fifty, in each industry, who came to the Truss Society in the years 1882 and 1887. By comparing each of these numbers of ruptured persons with the total number[3] in the corresponding trade between the ages of twenty one and fifty, a proportion is found, and, according to this proportion, a second list of trades has been made

(Column III.) In Column III. the relative frequency of hernia in the several trades determines the order of the names.

TABLE XV.—LABOUR LIST.

I. Names of Trades in Order of Numerical Frequency.	II. Number of Cases, 1882, 1887.	III. Trades in Order of Proportion Ruptured.
Clerks, commercial	138	Gasworks service.
Carpenter and joiner	326	Platelayer.
Carman, carrier, carter, haulier	458	Coal-heaver.
Shoe and bootmaker	158	Gardener.
Painter and glazier	218	Brewer.
Printer	179	Hawker.
Bricklayer	247	Dock labourer.
Tailor	118	Cellarman.
Cabinetmaker	106	Sawyer.
Baker	177	Blacksmith.
Butcher	153	Warehouseman.
Harbour, dock, and wharf labourer	316	Cooper.
Gardener	298	Carman.
Warehouseman	141	Baker.
Shopkeeper and shopman	89	Butcher.
Blacksmith	136	Shipwright.
Mason	72	Bricklayer.
Goldsmith, silversmith, jeweller, &c.	27	Shopman.
Plasterer and whitewasher	58	Bookbinder.
Musical instrument maker	22	Mason.
Tobacco manufacturer and tobacconist	10	Brazier.
Bookbinder	56	Plasterer and whitewasher.
Hawker and coster	152	Carpenter.
Stationer and law stationer	15	Painter and glazier.
Watch and clockmaker	25	Printer.
Brazier and brass manufacturer	42	Cabinetmaker.
Ship, boat, and barge builder	51	Tailor.
Cooper	66	Watch and clockmaker.
Gasworks service	204	Shoemaker.
Saddler and harness maker	16	Confectioner.
Confectioner and pastry cook	17	Saddler and harness maker.
Coal-heaver	136	Musical instrument maker.
Sawyer	59	Gold & silversmith, jeweller.
Brewer	86	Stationer.
Cellarman	56	Clerk.
Platelayer	57	Tobacconist.

The numbers in each trade are found in Census for 1881, vol. iii., p. 12 *et seq.*, Table X.

If Column I. and Column III. are now considered together, it is apparent that the proportion of ruptured persons in a trade is irrespective of the number practising the trade, but fairly corresponds with the severity of the toil.* At the beginning of Column III. are those whose work demands great muscular exertion, and at the end are those who use little.

* Mr. Kingdon was of opinion that the persons ruptured in each trade are in proportion to the numbers engaged in the trade (Med. Chir. Trans., *loc. cit.*).

The gardener takes a high place, because, perhaps, his position at the spade relaxes the structures of the groin at the moment of his most considerable effort. It has been observed that the foresters in the Harz Mountains suffered grievously from ruptures, and Stromeyer supposed that the stooping position, which they were obliged to adopt in cutting and binding wood, materially contributed to produce ruptures among them.† It is difficult to explain why the hawker is so high on the list, unless it is that he is not only ill-fed, but is compelled to strain when shouting to call attention to his wares.* The baker also is more frequently ruptured than might be anticipated. He has often to lift heavy weights, and is especially subject to the ill effects of an atmosphere impure with gas, moisture, and dust, whilst he is one who "makes the night joint labourer with the day." In consequence of these injurious influences, the baker is usually of a spare and lax habit of body, and hence he becomes liable to hernia, and particularly to femoral hernia. Among ruptured men between the ages of twenty-one and sixty-five, 3.9 per cent. have femoral hernia, but among ruptured bakers, 8.7 per cent. have femoral hernia.† Of ruptured gardeners, likewise, 5.2 per cent. have femoral hernia; and these men, though following a healthy occupation, are generally lean.

The change in the position of the commercial clerk from the top of Column I. to the bottom of Column III. is remarkable. Clerks are the most numerous body of men here classified, and yet, in proportion to their numbers, they yield the fewest ruptures with the exception of the tobacconists. No doubt many are in circumstances so easy that they do not seek relief from the charity; but the clerks, who come to the Society, are sufficiently numerous to warrant the belief that more would come, if more were ruptured.

It is not necessary, nor is it possible, to estimate very closely the liability of the members of the different trades to rupture. It must happen, that persons are often ruptured under circumstances wholly independent of their occupations, and in some cases that the nature of the trade affects the health injuriously, and thus aids, while it obscures, the effect of muscular exertion. The foregoing considerations, however, indicate in a general way that there is a distinct, though perhaps distant, relation between the severity of the toil and the numerical frequency of ruptures.‡

* In a list prepared by Dr. W. Ogle, showing the comparative mortality of men in different occupations, the hawkers and costermongers have the highest mortality after those engaged in hotel service. It is evident, therefore, that these persons are subject to debilitating influences of some kind.[5]

† The frequency of femoral hernia among bakers was first observed by Mr. Henry Knight, who keeps the records of the City of London Truss Society.

‡ A ruptured labouring man, who has taken much interest in matters affecting

The Effect of Parturition on the Female.—To determine whether parturition has any effect in producing ruptures, it is not sufficient to compare the number of single and childless women who are ruptured with those similarly affected who have borne children, because these two classes of women are not present in equal numbers in the population.

Between the age of twenty and forty-five, that is, during the child-bearing period, the number of single women in the London Registration District compared with the number of married women and widows was as 1 : 1.6 in the Census of 1881. But some of the single women were mothers, and a correction must be made on this account. The annual average of illegitimate births per 1000 women was equal to 10.5,[6] and by use of this fact the number of single women, who were mothers, can be calculated from the Census Tables of 1881.[7] The number of barren wives and widows can also be found by using the late Dr. Matthews Duncan's estimate of 10 per cent. as "the nearly true amount of sterility among married persons."[8] After making the deductions above specified, a comparison can be made of the number of barren wives and widows and of chaste spinsters with the number of fruitful wives, widows, and spinsters. Thus the ratio is obtained of the women, who have not borne, to those who have borne children. This is as 1 : 1.2 between the ages of twenty and forty-five, whilst among ruptured women between the same ages the childless are to the mothers as 1 : 2.7.

After the age of forty-five, the women who have not borne, are to those who have, as 1 : 5 among the ruptured, and this is the proportion that exists in the general population. This comparison of women during and after the child-bearing period demonstrates, that it is only during that period, that mothers are ruptured in greater proportion than childless women ; and as the principal difference between the two classes of women is parturition, this circumstance must be regarded as an important exciting cause of hernia.

Reduction in the Formation of Hernia after Fifty Years.—When the liability of the two sexes to hernia at different periods of life was dealt with in the Chapter on Statistics, it was shown that women between sixteen and fifty, that is, during the child-bearing period, are much more subject to ruptures than after that period. The fact is well seen in Table II., Part I., § I. and II., where a sudden fall in the number of herniæ after forty-six is manifest.

A reduction in the formation of hernia occurs likewise in the male sex at fifty (Table I., Part I., § I. and II.), for at that age many men either fail in health or seek employment less toilsome than before. But still

working-men, suggested to me that piece-workers, on account of the greater energy of their work, are more commonly ruptured than day-workers. He had taken some pains to satisfy himself that this is actually the case.

TABLE XVI.

Table of Female Cases showing the Incidence of Hernia in those who have and who have not borne Children. The Cases are arranged according to the Age of the Patient when the Rupture first appeared. The Second Column of Figures in each Division of the Table includes the Mothers, and the First Column the Childless Women.

	Total. 21-45		Total. 46-65		21-25		26-30		31-35		36-40		41-45		46-50		51-55		56-60		61-65		Total.	
Inguinal . .	61	178	7	34	22	45	17	37	6	44	12	29	4	23	3	13	1	13	1	5	2	3	68	212
Femoral . .	82	227	8	51	27	33	19	53	17	55	12	50	7	36	4	28	1	6	2	12	1	5	90	278
Total .	143	405	15	85	49	78	36	90	23	99	24	79	11	59	7	41	2	19	3	17	3	8	158	490

The ratio of femoral to inguinal is 1.3 : 1 both in the bearers and the non-bearers. Between 21 and 45 the ratio of femoral to inguinal is somewhat greater in the non-bearers = 1.34 : 1, than it is in the bearers 1.21 : 1. These facts are traversed by Mr. Kingdon in his oft quoted paper, p. 306, where he says that femoral is much more common than inguinal in those who have borne children, and among single women the two forms are more nearly equal.

large numbers continue the same work, and this persistence in laborious occupations, when the powers are failing, may explain the high proportion of hernia after fifty in men. In women there is no such cause in operation to keep up the production.

Exertion Influences the Severity of the Hernia and the Occurrence of Double Hernia.—The difference in the physical exertions required of the two sexes serves also to explain, in some measure, the larger proportion of scrotal among men as compared with labial herniæ among women. In male inguinal herniæ 18 per cent. are scrotal, whilst in female inguinal only 3.3 per cent. are labial. Moreover, the greater tendency to double hernia in men, which was established in the chapter above referred to, likewise indicates the energy and longer continuance of the exciting causes among males.

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2. **Malgaigne.**—Leç. Clin., &c., 1841, p. 40.
3. Census, 1881, iii. p. 12 et seq., Table X.
4. **Stromeyer.**—Inaug. Dissert. ü. Atonie fibr. Gewebe, Würzburg, 1840, p. 8, in Froriep's Neue Notiz., 1841, xviii. 172.
5. **Dr. W. Ogle.**—Br. Med. Jour., 1891, ii. 376.
6. Regist. Gen. Report, 1882, p. xii., Table E.
7. Census, 1881, iii. 9, Table VII.
8. **Matthews Duncan.**—Gulston. Lectures, 1884, p. 12.

CHAPTER XI.

ON THE DOCTRINE OF HERNIA.

Lengthened Mesentery as a Cause of Hernia.—The mesentery, which is connected with the intestine in a hernial sac, is sometimes lengthened, and this circumstance appears to have suggested that the lengthening of the mesentery precedes the hernia, and is the original cause of it. The earliest indication of this belief occurs in Wharton's Adenographia.[1] It was mentioned by Mery in 1701,[2] and was more fully developed in 1730 by J. C. Rostius.[3] This latter author was the first to announce that the intestine cannot pass beyond the limits of the abdomen unless the mesentery has previously yielded. He seeks to strengthen this supposition by pointing out that those who become ruptured by roughriding feel at first a painful tension about the umbilicus and loins. A more

elaborate treatise on the cause of hernia was published by A. Benevoli in 1747, wherein he adopts this theory of laxity of the mesentery.[4] So popular was the notion at one period in the last century, that Hoffmann, the elder, invented a magnetic plaster to be worn over the loins in order to reinvigorate the drooping mesentery.[5] One of the most illustrious exponents of this doctrine was Morgagni, who, however, qualified his acceptance of it by saying that a relaxation of the peritoneum and rings is also necessarily concerned in the production of hernia. Le Dran, Camper, and Stoll held the same opinion,[6] and also Richter. At the beginning of this century the theory was vigorously assailed by Scarpa, and, though it has survived, it has never regained its former estimation. After him it received very little attention till the publication in 1864 of Mr. Kingdon's well-known essay in defence of it.[7]

Fallacies of the Theory. The theory rests principally on the assumption, made by Rostius, that under normal conditions the attachments of the intestines are not long enough to permit them to pass the inguinal or femoral rings. Malgaigne demurred to this, and declared that "you can draw down the intestines and bring them beyond the limits of the abdomen."[8] Wood frequently found the intestines in the pelvis in subjects not ruptured, and argued that, if they could reach the pelvis, they could much more easily pass beyond the openings in the groin. But the normal excursion of the intestines was more carefully examined by Callender, who found in a large number of observations that "in all cases small intestine can readily prolapse from the abdomen."[9]

He constructed a diagram to show what parts of the intestine can be drawn beyond the hernial apertures, and what is the length of the excursion. He concluded that "as the intestine so easily passes beyond the lower boundaries of the abdomen, it is evidently an error to suppose that its protrusion (hernia) requires a prior elongation of this ligament" (mesentery); and referring to his diagram, he shows "that the right side is more favourably disposed for the occurrence of an intestinal hernia than is the left, for the nearer the small intestine approaches the cæcum (the six or eight last inches excepted) the more readily and the further can it protrude." The still more recent investigations of Mr. C. B. Lockwood[10] fully confirm the observations of the late Mr. Callender, and those, who have access to dead bodies, will have little difficulty in convincing themselves of the accuracy of these authors.* It is needless to pursue any further this doctrine, which is now sufficiently

* Mr. Treves, however, in his work on the Anatomy of the Intestinal Canal, &c., at p. 27 makes the following remarkable statement:—"It is impossible to drag a loop of small intestine through the femoral canal (artificially enlarged) on to the thigh or down the inguinal canal into the scrotum." This refers to fresh adult bodies with normal viscera and peritoneum.

discredited. None of those, who upheld it, have been able to establish as a matter of fact the principle on which it rests, and, as Zimmer said of it long ago, it can only be regarded as a simple and improbable conjecture.

Prolapse of the Mesentery as a Cause of Hernia.—In the work above alluded to, Mr. Lockwood has very carefully examined the length of the mesentery, and has not been able to convince himself that it is "a factor in the causation of hernia." But in the course of his investigations Mr. Lockwood has found that, as life advances, the mesentery is apt to glide down over the bodies of the vertebræ and to occupy a lower position than before, and that thus the intestine comes to bear more heavily on the lower, and especially on the left part of the abdominal wall. This is termed "prolapse of the mesentery." It is not present with herniæ in the tunica vaginalis and the like, nor in some ordinary herniæ where the defect is manifestly in the wall of the belly. Mr. Lockwood restricts this agency to herniæ of the ordinary kind, and thinks that it has the effect of first bulging the wall of the abdomen, and later of forming a hernial protrusion.

Defects of this Theory.—Among all the bodies examined by this author, there was not one in which the mesentery was so short or so high that a hernia might not have been formed. Part of the weight of the intestines, therefore, must under normal circumstances be supported by the wall of the belly. When prolapse of the mesentery occurs, this weight to be supported by the abdominal wall is augmented. But how much is it augmented? The average weight of the intestines and mesentery Mr. Lockwood found to be 26 ounces.[1] Therefore, with prolapse of the mesentery, the parts concerned in hernia have to bear an extra burden, equivalent to some fraction of 26 ounces, and it is evident that this fraction cannot be a large one.

Prolapse of the mesentery is not generally observed before thirty years of age. After that age, on account of the additional weight supposed to be thrown on the left hypogastric fossæ, an increase of single left herniæ or an increase of double herniæ formed from single right herniæ is to be anticipated. Mr. Lockwood consults a Statistical Table of Mr. Kingdon's for 1863, in which the cases are arranged according to the age of the patient and the side ruptured at the time of his visit to the Truss Society, and finds a considerable increase of left ruptures between thirty-five and forty-five. This is attributed to the effect of prolapse of the mesentery. Unfortunately this sudden accession of left herniæ in Mr. Kingdon's Table between thirty-five and forty-five is not constant. It is not found in the Tables, similar to Mr. Kingdon's, given in this book, nor in another Table constructed by the author, comprising 14,911 cases, nor in other Tables prepared by Mr. Kingdon himself. Therefore I look upon this sudden rise in the number of left herniæ

between thirty-five and forty-five, in the Table of 1863, as accidental, and as one of those anomalies that so often appear in statistics when a comparatively small number of instances is used. But considering the mode of construction of the Table, it is of very little consequence whether the apparent increase of left herniæ is constant or not, for the Table does not show the cases of left herniæ which originated between thirty-five and forty-five, but the cases between those ages that were ruptured during previous epochs. Mr. Lockwood has used a Table similar to Table I., Part II. in this book, instead of using one like Table I., Part I., which shows the ages at which the herniæ first appeared. By referring to Table I., Part I., or more conveniently to Table IV. in the same chapter, it will be seen that left herniæ keep the same proportion to right herniæ between the ages of twenty and sixty, and that after sixty the proportion of left to right becomes even less.

Still relying on the supposed increase of left herniæ between thirty-five and forty-five, Mr. Lockwood further illustrates his argument by referring to the production of double herniæ from single, but it has been shown that the increase of left herniæ is not constant.

Furthermore, Mr. Lockwood, in the fairest spirit, points out that ordinary herniæ may exist without prolapse of the mesentery, and that prolapse of the mesentery may be unaccompanied by herniæ.

This theory, like the former one, with which it has much in common, is open to the same objection that it can only account for protrusions at the dependent parts of the belly. This defect does not exist in those that remain to be examined.

The "Pull Theory."—One of them supposes that the hernial sac is first formed, and that the contents of the sac are added later. As the subperitoneal fatty tissue forms one of the coverings of every hernia, it occasionally happens that fat is found outside the serous sac in masses more or less circumscribed; but, independently of herniæ, the subperitoneal fat may form tumours at the parts where herniæ protrude, and may simulate them. Sometimes these subserous lipomata are accompanied by a tube of peritoneum of variable calibre.

From these facts it has been inferred that a subperitoneal lipoma may draw down a peritoneal pouch, and that this pouch may give place to a hernia. Pelletan, who compared the exit of these fatty tumours to the descent of the testis, suggested that they might contribute to the production of a hernia.*[12] Meckel collected some good instances, and, after describing a case of his own in which a subperitoneal lipoma was associated with a strangulated inguinal hernia, observed that "his case was

* Pelletan noticed his first case in 1780. Dr. Wernher found that Reneaulme de Lagarenne first indicated the apparent relation between fat masses, peritoneal pouches, and hernia.

so far interesting, as it seemed to prove, that this lipoma, especially if it is developed in the region of the inguinal ring behind the peritoneum, may give occasion by its weight to the origin of inguinal hernia and by its extent to the strangulation of the same."[13] A year afterwards Cloquet put forward the opinion that the subperitoneal fat attached to the peritoneum by a vascular pedicle may become involved in the inguinal canal or other abdominal openings, may take on a considerable growth, and may thus draw down the peritoneum to form a true sac ready to receive the viscera.[14] These writers regarded the development of a subserous lipoma as an occasional cause of rupture; but Roser, in 1843, endeavoured to remove the limitation, and to extend the operation of this cause to the majority of ordinary herniæ.[15] Since that time this notion has become the subject of much controversy, and still has its adherents.

Insufficiency of the Pull Theory.—The objections to this theory, which is called by the Germans "Zug Theorie," the Pull Theory, have been exposed by Wernher, with unsparing hand, in his Essay on the Mechanism of the Formation of Ruptures.[16] Though many have desired to explain the occurrence of the peritoneal diverticula in conjunction with subserous lipomata, none have yet succeeded in demonstrating the nature of the force which is supposed to draw down the peritoneum.

Lipomata derived from the subperitoneal fat are not uncommon, and are often multiple.[17] They are chiefly found in the linea alba, between the umbilicus and the ensiform cartilage, whilst their next most frequent seat appears to be the femoral region. They are occasionally associated with a pouch of peritoneum. Sometimes a lipoma, apparently identical with one of these, is found at the fundus or at the side of a hernial sac. They may project into a hernial sac, as was shown by Camper[18] and by several recent authors.[19] A hernia has been found on one side of the body, and a subserous lipoma with a peritoneal pouch on the other.[20] Hence it is inferred that a hernia sometimes enters a peritoneal sac which is connected with a lipoma. No one can doubt that this event occurs now and then, but that it is not general or even common may be ascertained from an examination of the cases, described by the authors already referred to.

In Fig. 1 a dissection of the left groin is reproduced in which two serous diverticula are seen on each side of a femoral hernia. This specimen was taken from the body of a woman between forty and fifty years old, who had had the rupture for several years.* The hernia is in the usual situation. One peritoneal pouch descends beneath Poupart's

* This woman was a parlour-maid, who died in a few hours of perforation of an ulcer of the stomach. I obtained the specimen through the kindness of Mr. G. H. Hames.

ligament over the femoral vessels: the other, at the inner side of the thigh, traverses Gimbernat's ligament. The abdominal entrance of both these pouches was narrower than the fundus, and both were surrounded by fat which has been partly removed by dissection. This case affords an illustration of the slight tendency possessed by these serous tubes to encourage the descent of a rupture. Here two tubes were present, but the hernia descended in the usual situation.

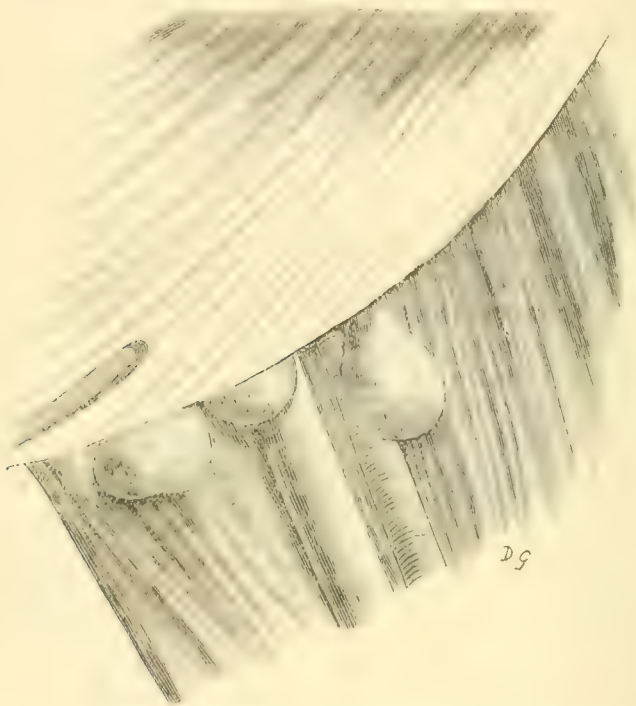

FIG. 1. Dissection of the left groin in which a femoral hernia had descended in the usual situation, a second peritoneal sac had traversed Gimbernat's ligament, and a third had protruded over and to the outer side of the femoral artery.—*Drawn by Mr. Donald Gunn.*

Some of these peritoneal diverticula have been thought to be obsolete hernial sacs, and the growth of fat about them has been regarded as a means for their obliteration.[21]

The Pressure Theory.—The progress of opinion on the formation of hernia has been briefly traced, in the third chapter, up to the disappearance of the error which attributed ruptures to laceration of the peritoneum. Much attention was given by the earlier writers to the peritoneum, but little to the openings by which it escaped. With the

dawning of the eighteenth century, however, a sounder doctrine of the origin of hernia began to prevail, and we find Abraham Cyprianus, in the year 1700, announcing that the "ordinary cause of hernia is debility of the tendons pertaining to the muscles of the abdomen, which, having been relaxed, easily admit separation of their fibres. For the peritoneum, because it cannot, of its own strength alone, sustain the weight of the superincumbent viscera, is little by little extended, and slides down through the interstices of the tendinous fibres towards the scrotum, and together with the intestines makes a hernia."[22] Somewhat later, Garangeot, who is thought to have derived his methodical arrangement

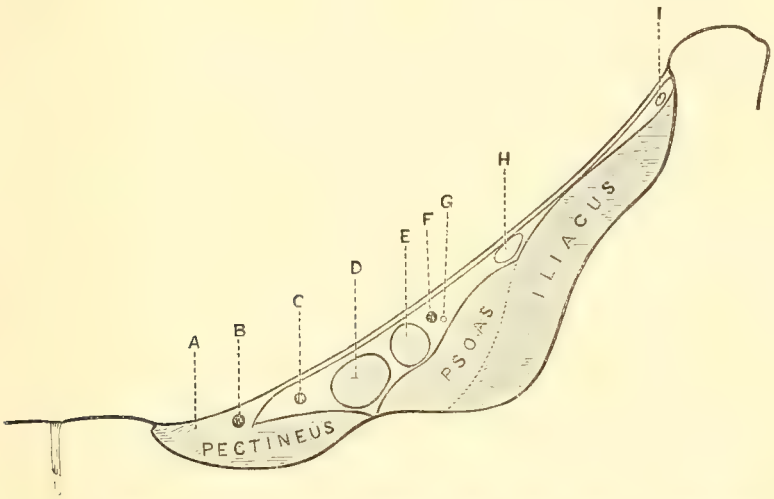

FIG. 2.—Diagram to illustrate Fig. 1, drawn by Mr. Donald Gunn. It represents a horizontal section of the left thigh at the level of Poupart's ligament. *A.* Gimbernat's ligament; *B.* Point of exit of the inner peritoneal sac; *C.* Point of exit of the femoral hernia; *D.* Femoral vein; *E.* Femoral artery; *F.* Point of exit of the outer peritoneal sac; *G.* Crural branch of the genito-crural nerve; *H.* Anterior crural nerve; *I.* External cutaneous nerve.

of the subject from Lagarenne, after describing the parts within the abdomen, which may leave their natural situation, and the openings through which they may pass, concluded that hernia can only occur by relaxation of all these parts produced by violent efforts.[23]

This doctrine underwent some modification in after years, and gave rise to the most popular of all the theories of hernia. It is the "Pressure Theory," the "Druck Theorie" of the Germans. It involves the notion that the abdominal wall is defective at the point of exit, and that the intra-abdominal pressure overcomes the resistance of the parietes at this one weakened spot.

Zimmer, who was one of the early exponents of this theory, has written of it in the following terms :—[24]

"Whilst man is in health, the muscular and membranous parts of the abdominal wall yield, so that, although they may suffer extension, yet they restore themselves at all points. But in hernia they admit of extension, yet do not perfectly recover themselves . . . whence it follows that true herniæ are tumours due to relaxation of the soft containing parts, and the contained viscera are pushed onwards from their natural situation to these places." And further, he says, "it is thus almost universally established, that unless hernia is congenital, or originates from malformation of parts or some other less morbid cause, either the strength of the peritoneum and abdominal muscles is so diminished that they are not competent to sustain any more the weight of the viscera, or the force of the abdominal muscles urges the viscera with great violence towards the weaker places of the abdomen."

The Gradual and Sudden Eruption of a Hernia. Here Zimmer alludes to the two different modes of origin of herniæ; to that in which the rupture descends gradually, and without appreciable strain, and to that in which the protrusion occurs suddenly at the moment of a violent effort.

At the first onset many patients feel pain, or a sensation as if something had cracked, during an exertion, and from that moment they date their rupture. The swelling in such cases is small at first, and gradually increases. Whether the protrusion begins in this way, or altogether insidiously, it usually advances step by step, and it is this gradual formation which in some measure makes the origin of hernia so difficult to trace. The sudden occurrence of a large tumour, the "plenary eruption" of a hernia, as Manchart termed it, has often been called in question and even denied. It has been argued that a muscular effort, by enlarging a hernia already existing and causing pain to the patient at the point of exit, has made him suddenly conscious of it, but that the period of its first formation invariably escapes his attention. Evidence can scarcely be obtained on this matter by direct observation, though Ambrose Paré appears to have witnessed the sudden descent of hernia in persons undergoing the torture. There is no sufficient reason to doubt the faith of the patient in every case, and to refuse to believe the histories of instantaneous formation. The herniæ in the tunica vaginalis are now generally allowed to have sometimes a sudden origin,[25] and it is very probable that direct hernia may arise in the same way.[26] The pre-formed sac in the first case explains the occurrence, and in connection with direct hernia there are certain facts which countenance the belief that it may come suddenly by bursting or splitting of the posterior wall of the inguinal canal.

Sudden Occurrence of Hernia with a Normal Abdominal Wall.—According to Sir Astley Cooper and others the pressure, exercised upon the viscera by the contraction of the abdominal muscles, may sometimes be so considerable as to produce a hernia, though beforehand the abdominal wall was sound. Various experiments have been made on the bodies of dead persons and living animals to ascertain the effect of intra-abdominal pressure, both when the abdominal wall has been intact, and when some of its layers have been divided It is not surprising that these experiments have thrown no light upon the cause of hernia, for the conditions which exist in man can hardly be secured during experiments, more especially the previous repetition of pressure at uncertain intervals during long periods of time.

There is no positive assurance that intra-abdominal pressure causes hernia, at a given moment of time, in a person whose abdominal wall is normal. The cases, which lend countenance to this view, are found among direct herniæ, but even in them it is highly probable, that the abdominal wall has been weakened before it gives way.

Possible Changes in the Abdominal Wall from Intra-abdominal Pressure.—But intra-abdominal pressure, when acting under circumstances unfavourable to the individual for long periods, seems capable of so altering the normal abdominal wall in some persons, as at length to effect a protrusion. The greater frequency of hernia according to the greater severity of the toil in some measure supports this supposition. Among men engaged in the same occupation, wide differences are noticeable in their physical powers, and thus laborious acts, oft repeated during fatigue, may have no harmful effect on some, whilst they may seriously weaken the muscular and aponeurotic structures of others.

Effect of Intra-abdominal Pressure on an Abdominal Wall Weakened I. By Age.—Mere debility of the wall of the belly seems to be sufficient to dispose to hernia in those advanced in life. A quite considerable number of persons become ruptured after the age of seventy, and though a congenital defect of the apertures may exist in them, it can be but of little moment, since it has brought about no protrusion during the active exertions of former years. When the muscles and aponeuroses of the lower abdomen have become lax in premature or timely old age, the impulse of the viscera upon them during cough or other exertion will be more sudden than it is, whilst they preserve their healthy tone. The difference in the effect upon them must be like that exhibited by applying a weight to a tight rope and to a slack one.

II. By Illness.—A temporary laxity of the tissues may be caused by illness at any period of life, and persons are met with not uncommonly who were ruptured when they resumed active employment during a convalescence. In the same context may be mentioned the rapid thinning

of a fat person whose aponeuroses have become thinner, and therefore weaker, by the previous distension.

III. By Posture.—The repeated adoption of particular attitudes, by producing a temporary relaxation of the structures of the groin, has been thought to give rise to hernia, and to this cause Richeraud attributed the frequent affliction of the monks of the Grand Chartreuse, who spent many hours of every day in the posture of devotion.

IV. By Defective Development.—The effect of imperfect development in producing rupture has been considered in a previous chapter, where an attempt was made to show that a protrusion will occur earlier or later in life according to the grade of the anomaly. The circumstances that determine the appearance of a hernia in adult life, when only a slight defect is present, may be sought in the changes that take place in the part during normal growth. Though the individual ceases to gain in height after twenty-five years of age, growth in other directions still continues, in which nearly all structures participate. It often happens that the closure of the middle line of the body, between the umbilicus and ensiform cartilage, is so far incomplete, that one or more small openings are left in the linea alba. During infancy and childhood these may be too small to allow the viscera to escape, but as the linea alba lengthens, the size of these apertures must also increase, and thus they may at last give passage to a hernia. From this illustration it may be inferred that the more or less defective natural apertures undergo some such changes as growth proceeds, and that these changes, together with the toilsome occupations in which men begin to engage, may account for the exceeding frequency of hernia in early adult life.

Effects of Fattening.—The fattening also which often occurs with the advance of years, by stretching the abdominal wall, will have the same kind of effect on apertures that are not quite normal, and the various circumstances before mentioned, which weaken the normal belly wall, will influence in even greater degree parietes already defective.

Summary.—The observations which have now been made with reference to the so-called "Pressure Theory" may be summarised as follows:—

The compression of the viscera by the abdominal muscles may produce a hernia suddenly or gradually at one of the weak spots of the belly wall.

Some original or acquired defect of the abdominal wall at those places is present in some cases, is probable in all.

In persons structurally perfect, the abdominal wall may undergo changes from repeated internal pressure under certain circumstances, or from disease and other debilitating influences, whereby it is at length unable to withstand the distension to which it is subject.

In those structurally imperfect, the defects may be so great as to give rise to early hernia.

With defects of lesser degree, the structures involved may undergo changes resulting from growth, or from the various debilitating influences above alluded to, which diminish still further the strength of the abdominal wall, till it no longer resists the intra-abdominal pressure.

Hence the principal cause of hernia would appear to reside in imperfection of the structures which form the openings through which herniæ escape. But one factor alone is not, as a rule, sufficient to determine the descent of a hernia, and this is attested by the occasional presence of a congenital opening without a protrusion.

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CHAPTER XII.

ON THE PARTS CONCERNED IN INGUINAL AND FEMORAL HERNIA.

The Parts Concerned in Inguinal Hernia.

The union of the skin with the subcutaneous tissue and of the subcutaneous tissue with Poupart's ligament produces the crease or fold of the groin, which forms a useful "landmark" whereby to distinguish inguinal from femoral hernia. Its direction, like that of the ligament to which it is attached, is oblique along the outer third and transverse along the inner two-thirds. It is lost below the outer pillar of the external abdominal ring. Between the layers of the subcutaneous tissue the superficial vessels ramify, and among them is the external pudic which crosses the spermatic cord near the inguinal ring, and is usually divided, as Le Dran observed, in the first incision of herniotomy.

The aponeurosis of the external oblique muscle extends over all the front of the abdomen as far back as a line drawn from near the anterior superior iliac spine to the tip of the cartilage of the eighth rib. That part which covers the inguinal region and forms Poupart's ligament, or the crural arch, is chiefly derived from the muscular digitations which arise from the eighth, ninth, and tenth ribs. At the inferior attachment the aponeurosis is somewhat drawn in, particularly near the spine of the pubes, where it is continued for a short distance backwards and outwards along the ilio-pectineal line. To this disposition is due the curving in or "tucking in" of the abdominal wall at its junction with the thigh.

The aponeurosis is composed of shining silvery bands or ribbons, having a general direction downwards and inwards, which form an

unbroken surface, except near the rectus abdominis, where the cutaneous nerves escape, and above the pubes, where an interval is left for the passage of the spermatic cord. The lower part of the tendon of the external oblique muscle is stronger than the upper part, and is further strengthened by a layer of fibres, which appear at and below the level of the anterior superior iliac spine, and cross the fibres of the aponeurosis almost at right angles. These are the "fibræ collaterales" of Winslow, the arciform or intercolumnar fibres of later authors. They may take part in closing the upper angle of the external abdominal ring, and they contribute to form a thin fascia * which descends on the spermatic cord and affords one of the coverings of an inguinal hernia under the name of the intercolumnar or external spermatic fascia.

The intercolumnar fibres may cross the middle line, according to Luschka, and unite with those of the opposite side, but they are subject to much variation, and sometimes are scarcely perceptible. They are said to be remarkably developed in old herniæ, and occasionally to offer a resistance to the knife of almost cartilaginous hardness. It is, however, very doubtful whether the firm tissue in front of the neck of some old inguinal sacs is due to hypertrophy of the arciform fibres, and it is probable that the importance of these structures has been much exaggerated.

The External Inguinal Ring.—Above the crest of the pubes the fibres of the aponeurosis of the external oblique diverge to make way for the spermatic cord. The opening thus formed is usually of a triangular figure, with the apex directed upwards and outwards, and with the base at the pubes. It is, however, sometimes oval, sometimes rounded in outline or even squared, and is subject to many variations, both of size and shape. Under normal conditions the external inguinal ring is just large enough to permit the passage of the cord, and it will not admit, in addition, the tip of the index finger either in the living or dead.† On the other hand, the external ring sometimes remains patent over the greater part of the canal. This is met with frequently in infancy soon after the passage of the testis, while the same condition may persist up to adult life. The ring was seen by Cloquet in several instances to be open within one or two inches of the anterior superior iliac spine, and this anomaly, though perhaps in less degree, is within the experience of every surgeon. The opening is much smaller in the female than in the male. Gaillard satisfied himself that in old age the ring becomes much larger than before, but it does not appear that he was able to verify this assertion.

* Described by Scarpa.

† The size of the external ring, according to Sir Astley Cooper, is 1 inch long and ½ an inch wide. Gaillard gives it as 8 to 10 lines high and 6 to 7 lines across; Richet, 2½ to 3 centimetres in its longest diameter.

Of the lateral boundaries or pillars of the external ring the internal is flat and thin, and is inserted on the front of the pubes. In the erect position of the body the inner pillar is a little in advance of, as well as above, the outer. Some of its fibres terminate on the surface of the pubes of the same side, while some cross the middle line to interlace with those of the opposite side and to end close under the pubic spine.

The outer pillar of the external ring is formed by a firm bundle of aponeurotic fibres which end at the spine of the pubes, though some pass on to the front of the symphysis and intercross with those of the other side. The deeper fibres of Poupart's ligament are derived from muscular bundles placed at a somewhat lower level than those from which the superficial fibres arise. By the curving in and widening of these deeper fibres as they reach the pubes, the floor of the inguinal canal is formed; part turn upwards in front of the conjoined tendon and rectus muscle to strengthen the inner wall of the canal, and part pass backwards to be attached to the ileo-pectineal line under the name of Gimbernat's ligament. The fibres which proceed upwards and inwards were especially investigated by Colles, after whom they have been named the "triangular ligament of Colles."* He described the ligament as a "strong triangular fascia arising by a pretty broad base from the crest of the pubes, anteriorly to the insertion of the internal oblique and transversalis tendons, passing immediately behind the external abdominal muscle until it reaches the linea alba, in which it terminates by a narrow point about 1½ inches above the pubes."

It was delineated in Sir Astley Cooper's first plate, but was not described by him. It has generally been regarded, since the time of Colles, as a derivative from the insertion of the external oblique, but Velpeau, Malgaigne, and Cruveilhier considered it a continuation of the internal pillar of the external ring of the opposite side. Henle termed it the reflected portion of Gimbernat's ligament. So far, however, as its effect in hernia is concerned, all are agreed that this expansion aids in strengthening the inner wall of the canal at the angle between the pubes and the rectus. The extent to which Colles's ligament protects the posterior wall of the canal, where it comes into view through the aperture of the external ring, was estimated by Malgaigne to amount to the inner third of the exposed space in man, and the inner half in woman. Malgaigne also observes upon the frequent variations in the degree of development of this ligament.†

* The ligament of Colles appears to have been previously described by Camper.

† M. Tuffier has found a second opening above the inner pillar of the external ring in a dissection subject. It was traversed by a small branch of nerve, not traced to its origin. This observer has not recorded the position of the point of exit of the ilio-hypogastric nerve in the same subject. (Bull. de la Soc. Anat., 1888, p. 416.)

Boundaries of the Inguinal Canal.—The inguinal canal is covered in front along its whole length by the aponeurosis of the external oblique, and over the entry of the spermatic cord some muscular fibres of the internal oblique and transversalis also take part in forming the anterior boundary and conceal the internal inguinal ring. These lower fibres of the internal oblique, which arise from the outer third or more of Poupart's ligament, are directed inwards over the cord, to be inserted, together with the transversalis, in the crest of the pubes in front of the rectus and along the ileo-pectineal line behind Gimbernat's ligament. Thus this lower part of the muscle describes a curve, whereby the fibres at the insertion of the tendon have a direction downwards and inwards. The muscular bundles of the internal oblique sometimes form with the cremaster an unbroken layer over the front of the cord along the greater part of the canal; but usually the inferior fibres of the muscle are held loosely together, and, as Henle remarks, are in "a sort of disorder." Some of the fibres separate and accompany the cord to form the cremaster, others pass over the cord to enter the conjoined tendon, whilst others still continue muscular till they approach the middle line, where they enter the sheath of the rectus.

The origin of the transversalis muscle from Poupart's ligament is somewhat less extensive than that of the obliquus internus, but the two muscles are here so intimately blended that it is not always possible to define the limits of either. The transversalis, like the oblique muscle, arches over the spermatic cord to enter the conjoined tendon. Sometimes it descends at its origin so low that it appears to take part with the internal oblique in forming the cremaster. In other instances it has no attachment to Poupart's ligament, its border being altogether above the inner ring and spermatic cord.

The conjoined tendon of the internal oblique and transversalis is inserted along the whole length of the crest of the pubes in front of the rectus and of the pyramidalis, when that muscle is present, and it extends outwards for a variable distance along the ileo-pectineal line behind, and in close contact with Gimbernat's ligament. Its outer edge is usually so ill-defined that it is seldom possible to indicate the exact line where it terminates. That portion of the tendon which is derived from the internal oblique has generally a less extensive attachment than that from the transversalis muscle, so that the space between the border of the rectus and the internal ring is closed by the two tendons conjoined at the innermost part, further outwards by the transversalis tendon alone, while near the entry of the cord there may be a space unprotected by tendon or muscle.

There is another structure which may take part in strengthening the posterior wall of the inguinal canal. This is a small muscular slip

attached to the horizontal ramus of the pubes, and passing upwards and outwards behind the transversalis, to lose itself in the aponeurosis of that muscle. It is about 3 millimetres broad, and was described and drawn by Luschka,[1] who named it musculus pubo-transversalis.

Before considering the arrangement of the fascia transversalis it will be convenient to refer briefly to the lower attachment and relations of the recti abdominis.

Recti Muscles.—These muscles arise on each side of the middle line by a flattened tendon in two distinct parts, of which one springs from the front of the symphysis, and the other from the whole length of the pubic crest as far outwards as the pubic spine. Hence the rectus is behind the greater part of the external inguinal ring, and affords it most efficient protection. The recti are contained in a sheath formed by the splitting of the tendon of the internal oblique, of which the posterior layer is united with the transversalis abdominis, and the anterior with the external oblique. A little below the level of the umbilicus all these aponeuroses pass in front of the rectus, leaving the deep surface of that muscle in contact with the transversalis fascia. The hinder layer of the sheath ends in a sharp concave edge with the concavity downwards, the so-called "semilunar fold of Douglas."

Transversalis Fascia.—The transversalis fascia which lines the inner surface of the anterior abdominal wall is, in the greater part of its extent, a thin membrane, but becomes stronger and more conspicuous near Poupart's ligament. This lower portion has been assiduously examined since the discovery of the fascia by Sir Astley Cooper, both on account of the passage of the spermatic cord through it at the internal inguinal ring, and of the share which it takes in forming the posterior wall of the inguinal canal. At the line of Poupart's ligament it becomes continuous with the fascia covering the iliacus muscle, but its attachment to this is interrupted at the passage of the femoral vessels from the abdomen, and there it dips behind the ligament to reach the thigh. It covers the conjoined tendon of the internal oblique and transversalis, and, proceeding backwards in close contact with Gimbernat's ligament, joins the fascia over the pelvic portion of the pectineus muscle.

The Internal Inguinal Ring.—A short space above Poupart's ligament, at a point midway between the anterior superior iliac spine and the spine of the pubes, the vas deferens, after turning round the epigastric artery in company with the spermatic vessels, enters the inguinal canal. As the cord leaves the abdomen it is invested by a prolongation of the transversalis fascia under the name of the "infundibuliform or internal spermatic fascia" (Cooper). When examined from the inside of the abdomen, after the removal of the peritoneum and subperitoneal fat, the internal inguinal ring appears as a crescentic edge over which turns the

vas deferens.* The fascia transversalis often possesses at its lower part bundles of firm, almost tendinous fibres, which pursue different directions. A well-marked band passes along parallel with Poupart's ligament below the cord, and spreads out towards the anterior superior iliac spine. This is the "outer portion of the fascia transversalis" of Sir Astley Cooper, the "outer limb of the internal ring" of Hesselbach, the "bandelette ilio-pubienne" of Thomson, and the "ligamentum inguinale internum laterale" of Henle. Some of its fibres can be traced as far inwards as the adminiculum lineæ albæ, behind the rectus.

Another band of fibres proceeding, like that just described, from near the angle between the rectus and the pubes, turns upwards as it approaches the internal ring and forms its inner boundary. This is the "inner portion of the fascia transversalis" of Sir Astley Cooper, the "inner limb of the internal ring" of Hesselbach, and the "ligamentum inguinale internum mediale" of Henle. The fibres of the fascia between the inner ring and the rectus, take for the most part a curved course upwards, and those bounding the internal ring have been traced by some to the outer part of the fold of Douglas. Braune calls this portion of the fascia, just internal to the inner ring, "the ligament of Hesselbach," and another band along the outer border of the rectus, also traced by him to the fold of Douglas, he has named the "ligament of Henle."[2] It is important to notice that these bands of fibres are not constant, and that the fascia transversalis may be merely a uniform layer of connective tissue over the inner wall of the abdomen.

The parts concerned in inguinal hernia have been recently described by Dr. K. Douglas in a thesis supported by thirty-four dissections, wherein he labours to establish the proposition that all the strata of the abdominal wall, except the external oblique muscle, are represented at the internal ring. Henle's ligamentum inguinale internum mediale, which has heretofore been regarded, under one name or another, as a part of the fascia transversalis, is considered by Dr. Douglas as pertaining to the transversalis muscle.

Subperitoneal Fat.—The subperitoneal fatty tissue forms a layer beneath the fascia transversalis, which varies in thickness according to the state of nutrition of the individual. The fat in that portion of the tissue which accompanies the spermatic cord occasionally develops locally and becomes a lipoma, which may simulate hernia or be associated with it.

* An interesting anomaly in the position of the internal ring has been described by M. Tuffier in the paper before referred to. He found, on each side, the epigastric artery arising near the common iliac from the external iliac. In consequence, apparently, of this high origin, the internal ring was raised much above its usual level, and the inguinal canal was almost vertical and direct (*loc. cit.*, p. 421).

The Peritoneum.—The peritoneum lining the lower part of the abdomen rests loosely on the parts in the iliac fossa, but over the internal ring and anterior abdominal wall it has a closer attachment. The site of the inner ring is commonly indicated by a shallow depression of the peritoneum, yet in many instances the serous membrane presents no irregularity in that situation. The remains of the obliterated processus vaginalis can sometimes be traced from the inner ring along the front of the cord as a delicate fibrous thread.

Besides the constituents of the cord already mentioned, the genital branch of the genito-crural nerve enters the cord at the internal abdominal ring, and is distributed on the cremaster. The inguinal branch of the ilio-inguinal nerve also accompanies the cord along the canal, and escapes by the external ring to reach the scrotum.

The epigastric artery and veins, in their course to the rectus muscle, skirt the inner border of the deep inguinal ring; and as the ring varies its position a little in respect to Poupart's ligament, being generally found just above it, though sometimes several lines higher up, so the epigastric artery may run along the inner margin of the ring* or be distant from it half-an-inch and more.

The Hypogastric Fossæ.—According to some authors, the epigastric vessels stand out a little from the abdominal wall, and cause a slight elevation of the peritoneum as it passes over them. This, the "plica epigastrica," is the outermost of the three peritoneal folds that bound the fossæ into which this region is divided. Behind the linea alba the remains of the urachus produce a central fold, the "plica medialis," which, like the "plica epigastrica," is fairly constant in position. Between these the obliterated hypogastric artery forms a third fold, the "plica arteriæ umbilicalis," whose place and whose prominence are remarkably variable. According to Cloquet, the hypogastric is generally behind the epigastric artery; Hesselbach generally found it behind the rectus, near the outer border of that muscle; and Hyrtl thought it was near the bladder more often than not; all comment upon its inconstant position.

Hesselbach drew attention to the plica epigastrica, and the triangular space between it and the outer edge of the rectus has long been called by his name. External to the plica epigastrica is the "fossette inguinale externe" of Malgaigne, or the "fovea inguinalis externa" of Luschka. Between the epigastric and hypogastric arteries is the "fossette inguinale interne" of the French author, or the "fovea inguinalis media" of Luschka. Internal to the hypogastric artery is the "fovea inguinalis interna," or the "fossette vesico-inguinale" or "vesico-pubienne" of Malgaigne. It is evident that the two internal fossæ must be reduced

* Hyrtl says 2 to 3 lines internal to the ring.

to one when the epigastric and hypogastric arteries coincide. These folds and fossæ have been found eminently useful in descriptions of the place of exit of inguinal herniæ; but whether they are instrumental, as some have conjectured, in determining the place of exit is a question still undecided.

According to Englisch, the hypogastric artery lies close to the abdominal wall in the young, but in those advanced in years it is shortened, and may stand out from the wall a distance of $1\frac{1}{2}$ inches. Consequently the fossæ on each side of the vessel are deepened as life advances.[3]

Length of the Inguinal Canal.—The length of the inguinal canal differs according to the age and sex of the individual. It is about 2 inches long in the adult male (Astley Cooper *). It is longest in the adult female, in whom it is four to five millimetres longer than in the male (Richet).

Just after the descent of the testis, the length of the canal is no more than the thickness of the abdominal wall; but as growth proceeds, the internal ring soon recedes from the external, and travels laterally outwards. Thus the valvular construction of the inguinal canal is established, and this contrivance has been justly regarded as a most important safeguard against the descent of a hernia. According to the foregoing description, the thinnest and least protected part of the inner wall of the canal is that adjacent to the inner edge of the internal abdominal ring, which fact in some measure explains the greater prevalence of oblique inguinal hernia.

The Parts Concerned in Femoral Hernia.

Gimbernat's Ligament.—That part of the insertion of the external oblique muscle which extends along the ilio-pectineal line from the spine of the pubes is named "Gimbernat's ligament," after the Spanish surgeon by whom, in 1768, it was demonstrated for the first time. It fills the angle between the ramus of the pubes and the crural arch, and in the erect posture has an almost horizontal direction. It is of a somewhat triangular figure with the apex at the pubic spine and with the base, which is slightly curved, looking towards the femoral vein. In early life it is insignificant, and the space between it and the femoral vein is so narrow that these structures are almost in contact. When the pelvis attains adult proportions, this ligament generally measures 8 lines from apex to base.† Sometimes, as before observed, the liga-

* Luschka gives for the length of the canal 3.5 to 4 centimetres; Cruvelhier says the length varies from 4 to 6 centimetres; Hyrtl, 1 inch to not quite 2 inches.

† The measurements of Gimbernat's ligament from side to side, as given by different authors, are expressed below in millimetres:—Cloquet, 13 to 22; Lawrence, 19 to 25; Hyrtl, 15 to 18; Cruvelhier, 15 to 20; Luschka, 20.

ment may be short and slender, or even wanting. Sometimes its fibres leave spaces between them through which a hernia has been known to pass.

Ligament of the Pubes.—The sharp ridge of the linea ilio-pectinea is surmounted by a strong fibrous band, termed by Sir Astley Cooper "the ligament of the pubes," to which Gimbernat's ligament is connected. It was observed by Verpillat that when the ligamentum pubicum is divided, the ligament of Gimbernat is released to some extent, and on this fact he founded the suggestion that in strangulated femoral hernia the parts might be liberated by making the incision directly downwards.

Structures Contiguous to Gimbernat's Ligament.—Several structures contribute to strengthen and to conceal Gimbernat's ligament. It receives support from the conjoined tendon of the internal oblique and transversalis muscles, which is immediately behind and in contact with it. The fascia tranversalis, likewise, is closely applied to it, and sweeps around its free edge to enter the thigh. Furthermore, a strong and distinct band of fibres proceeds from near the anterior superior iliac spine along the deep surface of Poupart's ligament as far as the pubic spine. This is the deep femoral or crural arch. The space enclosed by the horizontal ramus of the pubes, by the femoral vein, and the ligaments of Poupart and Gimbernat, was termed by the latter surgeon the "crural ring."* It is closed by the subperitoneal fatty tissue, which often here contains a lymphatic gland, and may occasionally acquire some density.

This occluding tissue is the "septum crurale" of Cloquet. If the gland is removed an aperture is left, and it is thus delineated by Sir Astley Cooper. The latter writer, however, considered the tissue closing the femoral ring as distinct from the subperitoneal fatty layer. The femoral vessels, as they leave the abdomen, are invested by fascia in front and behind, which constitutes the so-called femoral sheath.

Femoral Sheath.—The fascia transversalis passes under Poupart's ligament in front of the vessels to form the anterior layer, and the iliac fascia, which becomes continuous with that on the pectineus muscle, forms the posterior layer of the sheath. On the deep surface of Gimbernat's ligament these fasciæ blend with one another, and as they turn over its free border give to the ligament a rounded edge. The inner wall of the femoral sheath meets the vein obliquely, and leaves a funnel-shaped (infundibuliform) space between itself and the vessel, which is termed the "femoral" or "crural canal." It transmits the lymphatics from the thigh to the abdomen, and is about half-an-inch in length.

* The transverse measurement of the crural ring was given by Hesselbach as 10 mm. in the female and 5 mm. in the male. This bears out Monro's assertion that the ligament of Gimbernat is considerably broader in the male than in the female. Hence the crural ring is larger in the female than in the male.[4]

The relation of the fascia lata to the femoral sheath is next to be noticed, and may be simplified by the following considerations. Just below Poupart's ligament the femoral artery rests against the psoas and iliacus muscles, the anterior surfaces of the vessels and of the muscles being nearly on the same plane. Consequently, the fascia lata, which is here very strong, passes evenly over these parts without interruption; but at the inner side of the vein the pectineus, on which the vessels rest, is on a lower plane; and thus the fascia lata, as it turns round the inner border of the vein and sheath to enter the fascia over the pectineus, presents a curved border, extending from Poupart's ligament to the entry of the saphenous vein. This curved border is the falciform process of Allan Burns.

Falciform Process.—That the difference of level, just alluded to, produces the falciform process, has been shown by raising up the pubic portion of the fascia lata on a level with the outer or iliac portion, when the falciform process disappears. Though there is no break in the continuity of the fascia lata where its outer and inner parts join, the pubic portion sends outwards a thin layer beneath the femoral vessels, which is continuous with that forming the posterior wall of the femoral sheath. The iliac or outer portion of the fascia lata is attached to Poupart's ligament over the sheath of the vessels, and extends inwards as far as the pubic spine. This terminal part, which is the continuation of the falciform process, has been sometimes called the femoral ligament. At its attachment to Poupart's ligament the fascia lata also adheres to the superficial surface of Gimbernat's ligament, and thus it is that when the thigh is bent nearly to a right angle, and the fascia lata is relaxed, Gimbernat's ligament is much less distinctly felt.[5]

Saphenous Opening.—The falciform process, if it is traced downwards, at length curves inwards below the junction of the saphenous and femoral veins, and limits the space called the saphenous opening.* This space has no defined internal border. The fascia which covers the area of the saphenous opening is pierced by numerous lymphatic vessels proceeding through the femoral canal to the abdomen. Hence this part is called the cribriform fascia. In cases of hernia these small perforations are sometimes dilated, and the sac protruding through them appears to be divided into numerous sacculi. Hesselbach gives a plate which illustrates very well this condition (see Fig. 7).

The subcutaneous fatty tissue here consists of two layers, between which the superficial vessels ramify. The deeper layer is attached to the border of the falciform process, and, like the underlying fascia, is pierced by lymphatic vessels.

The position of the hypogastric artery and of the other vessels in

* This space usually measures, from above downwards, 1¼ to 1½ inches.

relation to the femoral ring remains to be noticed. It has been already shown that the course of the hypogastric artery is very variable, but it is said to be generally to the inner side of the neck of a femoral hernia.

The epigastric artery runs at some distance above and to the outer side of the femoral ring. The variations of this and of the other vessels will be more conveniently treated in the chapter on the operation for strangulated hernia.

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2. **K. M. Douglas.**—The Transversalis Muscle and its relation to Inguinal Hernia. Jour. Anat. and Physiol., xxiv.
3. **J. Englisch.**—Ueber Entwickelung der Inneren Leistenhernien. Mediz. Jahrbuch. Braun, &c., 1869, xviii. 142.
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5. **Monro.**—Ibid., p. 51.

CHAPTER XIII.

THE PATHOLOGY OF HERNIA—THE FORMATION OF THE SAC.

A HERNIA consists of a sac and of its contents. The sac may be formed first, and the parts which descend, may enter it at any period subsequent to its formation; on the other hand, the sac and its contents may come down together.

Distinction between the Pre-formed and Ordinary Sac.—Herein is the distinction between ordinary herniæ and the various kinds which depend upon a recognised arrest of development. It is not always possible to distinguish from one another, either in the living or dead, the two classes of sacs, and therefore much, which has been observed and written of hernial sacs, applies to them indifferently without regard to their mode of origin. In the following description of the structure of herniæ the sac itself will be first considered, both when it originates independently, and when the sac and its contents come down together.

The Parts of a Sac.—In every hernial sac, no matter when it is formed, the opening by which it communicates with the abdomen, is called the mouth, and the part which circumscribes the mouth, is the neck of the sac. The narrowest portion of the sac is usually the neck, and all below is named the fundus.

The Pre-formed Sac—The Tunica Vaginalis.—The sacs of the first

order consist of the tunica vaginalis in whole or in part. When this process remains completely open, the sac has much the same figure as that of an ordinary hydrocele. In both, the testis has the same position a little below the middle at the back of the cavity;* but in hernia the neck of the processus, instead of being obliterated, is continued up into the abdomen. The neck in such cases may extend from the inner to the outer inguinal ring, and form within these limits a narrow tube. The small diameter of the neck is one of the most characteristic features in these sacs, and is of very serious import on account of its effect in causing strangulation; and, in correspondence with the slender neck, the walls of the inguinal canal and external ring are often found to have suffered scarcely any dilatation.[1] It is by no means uncommon for a large scrotal hernia in the tunica vaginalis, though easily reducible, to have the external ring so small, that it will not admit even the tip of the finger; and one cannot but wonder, not that the intestines should pass freely, but that they should pass at all, through so narrow an opening.

Relation of Spermatic Cord to the Sac.—The spermatic cord is placed at the back of the sac, and, when viewed from within, projects sometimes into the interior, so as to be partially enfolded in a vertical duplicature of the serous membrane. The vas deferens is internal to the spermatic artery, and this relation is constant no matter how far apart the constituents of the cord may be separated.[2] With the lower portion of the sac below the testis the cord has, of course, no connection.

Associated with Anomalies of Testis.—In a previous chapter it was noticed that anomalies of the testis are very frequent with these herniæ, and that in at least 46 per cent. of the cases (Table XIV.) the testis has either failed to reach its normal size or its normal position.†

The occasional occurrence in the scrotum of the sac of the tunica vaginalis while the testis remains in the canal or abdomen has also been already referred to. A still rarer condition is met with when the testis and epididymis are separated, and the latter, more or less perfectly developed, descends with the processus vaginalis. It may even reach the lower end of the scrotum.

Constrictions of Sac.—Under normal conditions, the strong tendency of the processus vaginalis to contract contributes in an important degree to its closure, and this tendency is also possessed by it when the canal remains partly or wholly open. It is owing to this that, in hernia of

* Occasionally the testis in these herniæ is placed at the lowest part of the sac.

† The frequent association of rupture with ill-developed testis no doubt gave rise to the belief, so long prevalent, that the pressure of the hernia caused atrophy of the testis.[3] This notion survived almost to our own time. I do not remember to have met with an attempt to verify the assertion in any author. Boerhaave thought persons become impotent in this way.

the tunica vaginalis, constrictions of the sac are sometimes found at various parts. More commonly they occur at those places where obliteration of the processus normally begins, that is, just above the testis and near the mouth of the sac. When two narrowings exist in the same cavity, it may happen, though very rarely, that a piece of bowel descends and is strangulated by each constriction. An excellent example of this

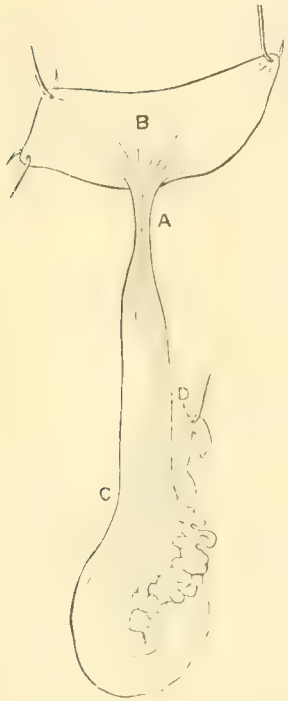

FIG. 3.—A. Processus vaginalis closed below the inner ring. B. Peritoneum. C. Tunica vaginalis. D. Vas deferens. (*After Cloquet.*)

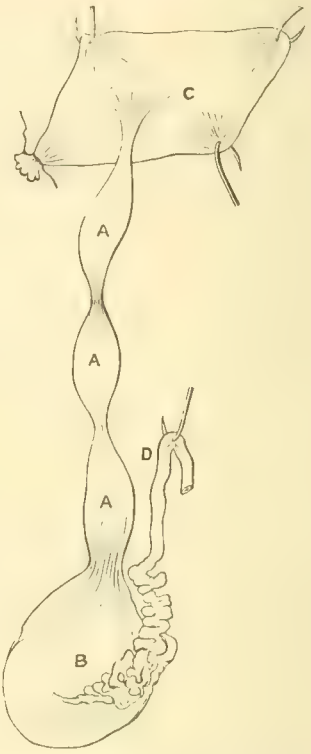

FIG. 4. Fibro-cellular cord extending from the peritoneum, C, to the tunica vaginalis, B, containing three serous cavities, A. The lower cavity is continuous with the tunica vaginalis. From a very old man. (*After Cloquet.*)

accident was described by Sir James, then Mr., Paget, in 1863, in a case where the upper contraction was at the level of the external abdominal ring, and the second 2 inches below this.[4]

Sometimes there is only one narrowing at either of the points mentioned (Fig. 3), or there may be more than two (Fig. 4). A constriction

occasionally exists at the site of the external ring, whilst between this and the opening into the abdomen the sac may undergo a dilatation within the inguinal canal. The extent to which the sac may be constricted varies considerably. There may be no more than a shallow groove encircling the sac, or there may be a complete partition perforated by a fine central opening, or any degree between these two conditions. Wrisberg found two of these partitions in the hernia of a young theological student, and likened them to the valvulæ conniventes.

Pouches in the Sac.—Still rarer and more difficult to explain are the recesses, or pockets, sometimes found at the back of the sac in hernia of the tunica vaginalis. These will be more conveniently referred to in the course of the description of infantile hernia.

Hernia in the Funicular Portion of the Tunica Vaginalis.—The tunica vaginalis may be closed at the upper end of the testis, and remain open above that point in its whole length; or the canal may be closed at any place intermediate between the internal abdominal ring and the top of the testis. Thus a portion of the processus vaginalis, varying in length in different cases, will be patent, and may become the sac of a hernia.* Camper drew attention to these facts in 1785, when he said: "What wonder then . . . that in those whose meatus are quite open about the testes, ruptures with no marked external cause descend into the sac of the testis? That in others they descend as far as the testis, or half-way down the cord, or even into the groin, according as this meatus is more or less obliterated?" [6] Many years afterwards Malgaigne described these herniæ under the name of "hernie vaginale funiculaire," and they are still commonly known as herniæ in the funicular portion of the tunica vaginalis.[7] The shape of the sac in funicular hernia is generally that of a narrow cylinder, and when this reaches the top of the testis, the attachment between it and the tunica vaginalis is so close that the testis seems sometimes to project upwards a little way into the fundus of the hernial sac. But these herniæ do not invariably possess a cylindrical outline. The author has seen a rupture of this kind in a boy (æt. 15), in whom the sac, below the external ring, was almost globular. In this patient the external ring was too narrow to admit the tip of the finger, a peculiarity which is common to these herniæ as well as to those in the tunica vaginalis.

Relation of the Cord to the Sac.—The relation of the cord to the

* The following extract from the treatise of Reneaulme de Lagarenne, 1726, which has been quoted by Pott, Wrisberg, and Wernher, gives the first indication of hernia in the funicular portion of the tunica vaginalis:—"Where the spermatic vessels, surrounded by an external membrane of peritoneum, are conducted from the ring of the external oblique to the testes, there in infants a blind duct occurs, which has the width of a pen and the length of the thumb, and is like those ducts observed by some anatomists in dogs, and described under the name of blind ducts." [5]

sac is the same as it is in hernia of the tunica vaginalis. The cord is closely applied to the back of the sac, and may form a projection into the cavity along the posterior wall, as before described. The intimate connection of the cord with the sac must be limited according to the length of the processus vaginalis which has remained open, and it is easy to perceive that, where this has been inconsiderable, there will be no material difference between funicular and ordinary hernia in regard to the relation of the spermatic cord.*

Change in Condition of Sac.—In cases which have been under treatment, it happens not infrequently that a hernia, which was at first in the tunica vaginalis, becomes at a later date a hernia in the funicular portion from closure of part of the processus vaginalis. Meckel conjectured that this might occur,[9] and Cloquet observed it. The author has had many opportunities of marking the change from the one condition to the other.

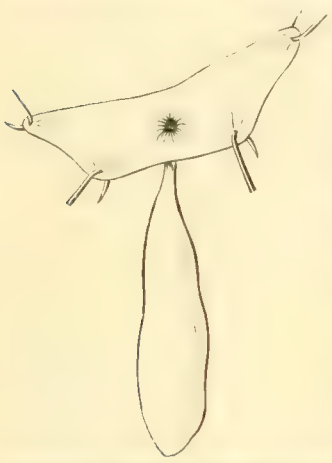

FIG. 5.—Peritoneal diverticulum in the inguinal canal accompanying the round ligament. From a woman, æt. 20. (*After Cloquet.*)

Hernia in Canal of Nuck.—Of hernia in the canal of Nuck little need be said beyond the statements already made in Chapter VIII. The canal most commonly presents itself as a small flattened cylinder (Fig. 5). Its upper opening is somewhat crescentic in outline, and invests the round ligament in front and externally, as it enters the inguinal canal.[10] In cases where the canal of Nuck is fully represented, it accompanies the round ligament, and follows the labial division of that structure, after it emerges from the external abdominal ring. The same course will be taken by the viscera when they occupy the processus of Nuck, and the round ligament will be prominent on the posterior wall of the sac at its upper part.

Infantile Hernia.

The species of hernia known as "infantile" was seen by Hey of Leeds in 1764, and up to the present time he has generally been credited with its discovery. But there was another surgeon, earlier than Hey and no

* M. Broca has investigated the coverings of the ordinary and of the pre-formed sac, and is disposed to think that they can be distinguished in dissections by the presence or absence of a covering from the fascia transversalis. In the first case there is a layer of fascia transversalis between the fibrous sheath of the cord and the sac; in the second case the sac is within the fibrous sheath of the cord.[8]

less famous, whose description of this disease might well entitle him to contest and to claim the priority. M. Mery, in 1701, narrated a case which was undoubtedly of this nature, but unfortunately he did not stamp it with a name.[11]

M. Mery's Case.—A man, æt. 70, arrived at the Hotel Dieu on August 20, 1701. He had a strangulated inguinal hernia on the right side as large as a goose's egg. The symptoms betokened mortification of the bowel within, and, as in those times gangrene was looked upon as necessarily fatal, M. Mery thought the patient should be left to die. M. Petit, however, urged the operation so strongly that M. Mery performed it. He divided the coverings of the tumour, and "no sooner were they opened than a blackish, fœtid fluid escaped and left a large cavity, in which I saw the testis sound and naked." He expressed his astonishment at this, and his still greater astonishment when he saw "a blind gut, 'un intestin aveugle,' in this open tumour, healthy, and not tense, instead of being gangrenous, as I had anticipated.* From the groin to the bottom of the tumour it was separated from the membranes of the scrotum, but it was so closely united to the ring of the abdominal muscles that, despairing of overcoming the adhesion without rupturing it, I proposed to M. Petit to leave it, and to content ourselves with dilating the rings, of which he did not approve. I then separated this supposed intestine from these parts of the muscles, and returned it to the belly. I perceived that in returning it into the belly it was still adherent to the peritoneum."

As M. Mery thought the bowels would not be obstructed by this adhesion, he concluded the operation. During the next four days the bowels acted and the vomiting ceased, but hiccough and delirium came on, and the man died. At the post-mortem, the portion of ileum that had been strangulated was gangrenous, and a rupture of this part had occurred through two-thirds of the circumference of the gut, permitting extravasation of fæces. The gut was nowhere adherent. After careful examination of the parts in the groin, "I found I had been mistaken, and that the part which I had taken for 'un intestin aveugle' was only the peritoneum prolonged in the form of a cul de sac into the scrotum. In ordinary hernia the prolongation of peritoneum (sac) is always found united to the membranes of the scrotum on the one hand, and to those of the testicle on the other; on the contrary, in this hernia it (the sac) was entirely separated from the one and the other."

He deprecates criticism, and says surgeons had better try to resolve the questions—1st, How to discern the peritoneal cul de sac (the sac) from the intestine; 2nd, How to discover the cause which was able to

* He appears to have pricked this "intestin aveugle" with his bistoury, as he mentions a hole in it that would admit a pin.

separate the cul de sac from the scrotal membranes, and to expose the testis in the tumour.

This case appears to admit of only one interpretation, and is so clear and circumstantial that it is surprising it has received so little attention from the profession. Even Mr. Lockwood, who has done so much to elucidate the mystery of infantile hernia, makes no mention of it.*

M. Le Cat also described a case, in 1750, which appears to be of this nature, but it is not given with such full detail as M. Mery's.†

It is not necessary to quote the passages in which M. Mery attempts to explain the mode of production of this hernia, for at that time the development and transition of the testicle were unknown, and without such preliminary knowledge the pathology of infantile hernia cannot be demonstrated. Hey accounted for the appearances in his case by supposing, first, that the tunica vaginalis became closed at the internal inguinal ring, and remained patent elsewhere; secondly, that the peritoneum at the point of obliteration was protruded by some viscus and stretched and caused to descend behind the processus vaginalis, which contained fluid. Thus a hernial sac would project into a hydrocele of the processus vaginalis. Sir Astley Cooper entertained much the same opinion of the origin of this hernia,‡ and this explanation continued to satisfy the inquiries of the profession up to 1886, when Mr. Lockwood enunciated his doctrine of infantile hernia, and completely overset the previous notions.[13]

The Two Forms of Infantile Hernia.—It will be convenient, before explaining the mechanism by which these herniæ are brought down, to describe the two most common and earliest recognised forms of the disease.

The First Form.—Of the one kind, Mery's case gives a very faithful

* The foregoing remarks appeared in the Br. Med. Jour., March 26, 1892, vol. i. p. 652.

† Francis le Mounier, a coachman, æt 65, was seized with symptoms of strangulation on 19th February 1750. Le Cat had some years before reduced the hernia under similar circumstances. He operated on 21st February 1750, at eight in the evening. "Having laid the bag open in the usual manner, which contained a little watery humour in it, I was much surprised at discovering within this bag a second bag or pocket, which could be nothing but either a second herniary bag or an incomplete hernia. But first, upon pressing this bag, all its contents returned into the abdomen; secondly, the patient assured me, even at the instant, that his rupture had kept up since its reduction in 1748; and I found this bag adhering not only to the first bag, but also attached by old and strong adhesions to the testicle and spermatic vessels. . . . I separated the testis and spermatic vessels from this sac, and pushed back this pocket or second bag into the belly." Death occurred on the ninth day, and at the post-mortem "we found the pocket, reduced into the belly, to be a herniary sac formed of peritoneum."[12]

‡ Sir Astley Cooper supposed that a small part of the processus was open above the external ring and all below, and that the bowel descended and pressed this upper into the lower portion of the processus.

account. This may be further embellished by a few words from the narration given in Sir Astley Cooper's work by T. Forster.

"When the scrotum was divided," Forster says, "the tumour was brought in view, taking the course of the spermatic cord, evidently involved with it, and much contracted at the ring.* On investigating further, and cutting carefully through the tunica vaginalis of the cord near the ring, a fluid escaped. I then continued the incision to the bottom of the scrotum through the tunica vaginalis of the cord and the tunica vaginalis testis, which I now found to be one cavity, the edges of which, being turned back on either side, exposed a hernial sac pendent from the ring and descending towards the testicle."

In this form the hernial sac is not connected with the tunica vaginalis except at the neck and just below it, but, for the most part, hangs free in the cavity.

The Second Form.—In the second and much more common form the appearances are somewhat different. The tunica vaginalis contains the sac, and is, as in the last case, closed around it at the neck; but, moreover, the posterior wall of the tunica vaginalis is intimately united with the back wall of the sac in its whole length. In continuation with this attachment a serous fold (plica vascularis) descends from the fundus of the sac to the testis. The most perfect specimen of this kind is in the Museum of St. Thomas's Hospital, and has been delineated in Teale's work and in Mr. Lockwood's essay.[14] In this preparation the testicle, plica vascularis, and hernial sac appear as if attached by a common mesentery to the deep surface of the tunica vaginalis.

In both the forms of herniæ now described the sac is intimately connected with the tunica vaginalis at the neck, where the spermatic vessels pass; but below the neck the sac is free in the first case, and attached along the back of the tunica vaginalis in the second. By dissection it is found that the serous membrane of the tunica vaginalis is reflected over the sac in both, only the line of reflection is more extensive in the first than in the second instance; so that in both forms, when approached from the front, there are three layers of peritoneum between the bowel and the skin.†

Between these typical forms there are various intermediate degrees, and it was partly by a study of these that Mr. Lockwood was able to show the identity in origin of the two forms.

Formation of the Sac.—In order to make clear the somewhat complicated process by which infantile sacs are thought to be produced, it

* "The ring" in early writings always means the external inguinal ring.

† Mr. Lockwood has shown that the so-called "encysted hernia," in which only two layers of peritoneum are supposed to intervene between the bowel and the skin, is a mere figment of the imagination. *Op. cit.*, p. 496.

is necessary to recall a few facts observed during the transition of the testis. These chiefly concern the structure named gubernaculum testis in the fœtus, and its relation to the processus vaginalis and to the peritoneum at the back of the abdomen. The gubernaculum, when fully developed, may be traced downwards, as before noticed, to the scrotum and pubes, sometimes to Scarpa's triangle and the perinæum. If it is followed upwards, it forms a bulbous enlargement where the processus vaginalis enters it, and passes on behind and within that process to the back of the testis. Above the testis it is contained in a fold of peritoneum (plica vascularis) together with the spermatic vessels, and ends principally in the mesentery common to the cæcum and termination of the ileum, on the right side, and beneath the sigmoid flexure on the left. The unstriped muscular fibres, of which the gubernaculum is largely composed, are inserted into the extremity of the processus vaginalis, and may be traced upwards to the peritoneum lining the lower and back part of the abdomen, or even beyond these limits.

It is not necessary to repeat the various reasons which conspire to make it probable that the muscular fibres of the gubernaculum are of service, under normal circumstances, in causing or assisting the descent of the testis. Assuming that they possess some such power, it remains to be seen how the irregular exercise of it may determine the formation of an infantile sac.

Among the numerous infantile herniæ examined by him, Mr. Lockwood was always able to detect "a fold of peritoneum or a fasciculated band of tissue," more or less distinct, proceeding from the globus major to the lower extremity of the hernial sac. The fasciculated tissue was examined and found to consist of smooth muscular fibre which extended from the epididymis to the extremity of the sac, and even between the two layers of the same as high up as the neck. These muscular fibres resemble (in relation to the serous membrane, the spermatic vessels, and the epididymis) those of the normal gubernaculum, and may be regarded as the remains of that structure. Mr. Lockwood has pointed out that if traction is made on the gubernaculum in a fœtus, in whom the testis is about to pass through the abdominal wall, not only the processus vaginalis and testis move downwards, but also the peritoneum lining the posterior wall of the abdomen.

The inference is, then, obvious, that if the processus vaginalis and peritoneum of the iliac fossa are drawn down by the muscular fibres of the gubernaculum under normal conditions, these fibres may be instrumental, under exceptional circumstances, in bringing down a second process of peritoneum. A hypertrophy of the smooth muscular fibre appears to be present in infantile hernia, and it is supposed that the undue traction hereby exercised upon the peritoneum of the iliac fossa produces, as it were, two processus vaginales instead of one. Theoretically, these

processes need not be limited to two, and in fact pouches are occasionally found on the posterior wall of infantile sacs which countenance this supposition.

For the perfect manifestation of infantile hernia it is essential that the tunica vaginalis should be capacious. In the Museum specimens that cavity is generally of considerable magnitude, and reaches upwards usually to the neck of the sac. The various appearances which these herniæ present are to be attributed partly to the amount of distension and consequent elongation to which the sac has been subjected, and partly to the state of the tunica vaginalis, as regards patency or obliteration. If the sac has been much distended, it will probably be more free in the cavity of the processus vaginalis, and approach more nearly to that variety where it is said to be "pendent from the ring."

As regards the state of the processus vaginalis, Mr. Lockwood thinks he has been able to define four varieties, depending upon differences which are represented in the following diagram * (Fig. 6).

In Nos. 1 and 2 the processus vaginalis communicates with the

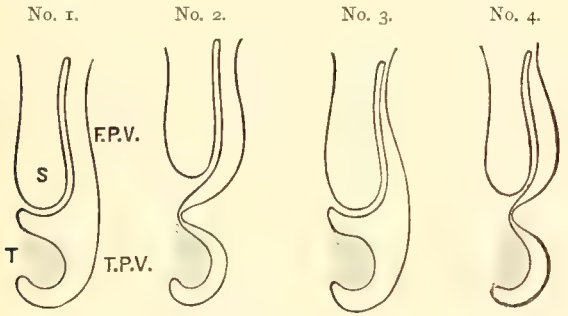

FIG. 6.—Diagrams showing the varieties of infantile hernia. S. = Hernial sac. T. = Testis. F. P. V. = Funicular portion of tunica vaginalis. T. P. V. = Testicular portion of processus vaginalis.

abdominal cavity; in Nos. 3 and 4 the process is closed at the upper end. Nos. 2 and 4 represent infantile hernia in the funicular portion of the tunica vaginalis. The closure of the processus above the testis and at the inner ring may give rise to a cyst (encysted hydrocele of the cord) in front of the hernial sac, as was observed by Mr. A. Wright.[15]

Pouches in Sac Wall.—The pouches which are sometimes found in the posterior wall of these and other herniæ of congenital origin have been already mentioned as being probably formed in a manner similar to that of the hernial sac itself, but appearances are occasionally met with which suggest another mode of origin. The spermatic artery gives

* I am indebted to Mr. Lockwood for permission to reproduce this diagram.

off branches to the peritoneum, especially in the neighbourhood of the internal inguinal ring, which take a retrograde course.[16] Hence it may be inferred that this artery, as it descends with the testis, moves more rapidly than the peritoneum. It is not difficult to imagine, therefore, that a branch may sometimes draw down a portion of peritoneum in advance of the rest, and thus produce a pouch or fold. A case recorded by Lejard illustrates very well the practical importance which the diverticula in congenital sacs sometimes acquire.[17] A large hernia in the tunica vaginalis was apparently reducible, but as symptoms of strangulation continued, Lejard opened the sac, and found at the back and inner side of it a small diverticulum of the wall in which a loop of intestine was tightly strangulated.

Interstitial hernia involves so many considerations, beyond those merely pathological, that it will be more conveniently treated in a future section, to which the reader is referred for a description of the constitution of its sac.

The Ordinary Sac Its Formation.—The sac of an oblique inguinal hernia may be used as the type of an ordinary sac, because this is the most common of all hernia, and the stages of its formation are most easily watched. At first a slight bulging appears at the site of the internal inguinal ring, which is only noticed when the abdominal muscles are in action, and which disappears again as the action ceases. It is better appreciated by the sight than the touch, as Malgaigne said. The peritoneum returns unchanged to its place by virtue of its natural elasticity. This faculty of the serous membrane of undergoing distension and recovering itself long since engaged the attention of Scarpa and Cloquet, and became with them the subject of experiment. After describing the variations in the thickness and strength of this membrane in different individuals at the same part, and in the same individual at different parts, Cloquet goes on to show that the very thin and delicate kind may possess the same degree of elasticity as the thick and strong. He stretched the peritoneum over a ring, and loaded it with different weights. He found that it was thus depressed into a pocket, and returned to its original state when the weight was removed; but in some instances, according to the amount of the weight or the duration of its application, the recovery was imperfect, and a permanent dilatation remained, just as it appears to be with the peritoneum at one of the openings where hernia occurs. After repeated bulgings the membrane at length yields, and preserves the form impressed upon it. A pouch comes forwards over the spermatic cord, and lengthening, as it descends the inguinal canal, becomes funnel-shaped, or like the finger of a glove. In this stage the mouth of the sac is its widest part. The peritoneum lining the lower part of the abdominal wall is so closely connected with the transversalis fascia that

it hardly admits of displacement, but in the iliac fossa its attachments are quite loose.* It is, therefore, from the peritoneum below the internal abdominal ring that the hernial pouch is probably furnished.

Whether the hernial sac is formed by displaced or distended peritoneum is a point that has given rise to some difference of opinion. The facility with which the peritoneum permits of change in the shape and in the position of viscera without any manifest change in itself, makes the question difficult to determine.[18] In certain very large ruptures the peritoneum in the abdomen is obviously displaced; so also in the first stages of the formation of the sac the serous membrane probably undergoes a change of place. But the sac soon adheres to neighbouring parts, and its further increase appears to depend upon a gradual extension. Such is the opinion generally held by the best writers up to the time of Malgaigne, who has endorsed it; but it is not the doctrine of Cloquet and Demeaux.

When the sac is of recent formation it is possible to draw it within the abdomen in the dead body, but it is doubtful if this often occurs under the ordinary conditions which are present in the living. During the operations for the so-called "radical cure" of hernia frequent opportunities occur of determining the reducibility of sacs, and it is almost always necessary to make some dissection to free them from the attachments which hold them in place. It is improbable, then, that with ordinary taxis the sac returns after its contents. A few preparations of Cloquet's, however, give some countenance to the belief that a hernial sac may return spontaneously under favourable circumstances, that is, if it is no longer filled by viscera; and changes in the abdominal contents are sometimes followed by the disappearance of the hernia, and thus, presumably, by the reduction of the sac. It is not uncommon for a rupture to disappear during pregnancy and remain cured, as if the sac were withdrawn from the canal by the rising of the uterus.[19] Yet it by no means follows that the cure of the hernia involves the reduction of the sac.

The presence of the sac in the inguinal canal causes stretching of the anterior wall, so that the tendon of the external oblique, when the muscle is in action, presents an elevation, as if it covered a tube. But this dilatation is not always confined to the anterior wall, for sometimes the posterior wall of the canal yields to a much greater extent, and makes a considerable projection into the abdominal cavity.[20]

When the sac has passed beyond the external inguinal ring, and meets with less resistance, it dilates in all directions, and takes a flask shape

* This looseness of the peritoneum in the false pelvis was noticed by Hunter, and has lately been insisted upon by Mr. Lockwood as showing whence the sac is derived.

or pear shape. If left unchecked it may attain a very large size, until its further increase is limited by there being no longer any viscera in the abdominal cavity capable of displacement. In the scrotum the sac is enclosed within the sheath of the spermatic cord, and oftentimes the two become intimately blended together.

The Sac Wall.—The serous membrane forming the sac is generally of the same thickness as that of the peritoneum from which it is derived, or it may be a little stouter, but the coverings of the sac sometimes become very dense. Arnaud cut through the sac of a very old bubonocele which was 6 lines thick, and De Haen saw twenty layers divided before the peritoneum was reached.*[21]

The density of the coverings, however, does not invariably correspond with the age or the size of the hernia. In some large and old ruptures the parietes are so thin that the form and movements of the intestines can be seen through them. It is usually in femoral and umbilical herniæ that this occurs. The integuments may even become so attenuated that they give way spontaneously. A woman, fifty-four years of age, had had an inguinal rupture for ten years, and never having worn a truss, the tumour at length reached a very considerable size. At the lower part the skin became eczematous Whilst she was one day walking in the street, and not making any particular effort, the hernia suddenly burst with an audible snap. She sank down, and her bowels rested on the ground. Recovering herself in a few moments, she gathered up the intestines in her apron and made the best of her way home to bed. She lay there for seven hours before Dr. Schäffer saw her.[22] He found a rent in the sac, 8 centimetres long, through which the bowels protruded. After the gut had been cleansed and returned, the wound was sutured, and the woman recovered.

In some cases all the parts of the sac wall are thickened, and in them the serous lining generally shows traces of inflammation. Thus the lining of the sac in old herniæ often presents folds and wrinkles, which generally run in a longitudinal direction, or the interior may have a mammillated appearance. Michon found at the lower part of a scrotal sac an interlacement of fibrous bands closely resembling, except in colour, the fleshy columns of a hypertrophied auricle.[23] The wall of the sac is, in rare instances, much indurated in old persons, so as to have almost the consistence of cartilage. Cloquet found this to occur in the form of irregular plates, which were sometimes present in large numbers, and which had unaltered spaces of the sac wall intervening between them. The inner surface of these plates is smooth and serous, and they may project into the hernial cavity. They have now and then been found

* It was found by Theden three-quarters of an inch thick. (Neue Erfah. ii., quoted by Hancock on Hern., 1850, p. 30.)

affected with calcareous degeneration.* Sometimes the wall of the sac suffers degenerations of other kinds. Jonnesco [24] has collected several cases in which the sac was infiltrated with tubercle. In other instances malignant growths extend from the viscera in the sac to its wall.

Relation of the Spermatic Cord to the Sac.—An oblique hernia always comes out at the internal inguinal ring above the constituents of the spermatic cord, and as it makes its way down the canal has the cord behind and the cremaster muscle in front of it. When the hernia becomes scrotal, the cremaster still forms one of the anterior investments of the sac, and often undergoes considerable hypertrophy. It then covers the front and sides of the sac with a tracery of strong muscular bands, which may be as much as 1 centimetre wide and 2 millimetres thick.[25]

Mouth of the Sac.—When the hernia is fully formed the mouth of the sac is usually rounded in outline, but it is sometimes oval or merely a narrow chink. Its size varies within very wide limits, for it may be so large as to admit the hand, or so small as to prevent the entry of the little finger.

In very large scrotal ruptures the mouth of the sac enlarges, chiefly at the expense of the inner portion of the posterior wall of the canal, till the internal abdominal ring is directly behind the external ring, and the obliquity of the canal is destroyed. This takes place, however, much less frequently than the statements of authors seem to imply, for there are very few oblique herniæ in which the oblique direction of the neck is not manifest, and in which a considerable part of the posterior wall of the canal is not preserved.

The neck of the sac in oblique inguinal hernia is the part between the external and internal abdominal rings, or if the sac begins to dilate immediately after passing the latter ring, it is the part adjacent to the mouth. In fully developed herniæ it is usually the narrowest part of the sac. The peritoneum, where it passes through the aperture of exit, is thrown into radiating folds or wrinkles, like "a purse drawn through a ring." These folds are not found in every case; there may be but one, or they may be present only at the part where the neck of the sac meets with much resistance, as at the inner border of the internal ring or at Gimbernat's ligament. Traces of these folds may often be seen about the mouths of sacs as delicate radiating lines, termed by Cloquet stigmata.

Demeaux supposed that if the sac is drawn back into the abdomen soon after its formation, the folds or wrinkles at the neck disappear. But if the sac remains *in situ*, the sides of the folds adhere and the neck becomes permanent. The folds at first cohere by means of the plastic

* A large bony plate, 3 inches by 3 inches, at the bottom of a hernial sac, is seen in a preparation in Guy's Hosp. Mus., No. 2494, as also in Nos. 291 and 292 in the Musée Dupuytren.

effusion so common in serous membranes, and ultimately are more or less obliterated. Demeaux described an abundant vascularisation of the subserous tissue of the part with vessels converging towards the neck of the sac, as a preliminary to the union of the folds and the organisation of the neck. This vascularisation has not been observed by later authors. In a subsequent stage Demeaux[26] thought the neck underwent contraction, and was no longer capable of dilatation.

The neck of the sac may preserve its original consistence, apparently for an unlimited period, but it may, on the contrary, become indurated and thickened. M. Gosselin has shown that, without undergoing any manifest change in thickness, it may become wholly inextensible.[27] In some cases the neck of the sac is surrounded by a dense ring of fibrous tissue; or the peritoneum itself may be indurated and form an annular thickening, as may be seen in some specimens in our Museums.

Peculiarities of the Sac.—The unusual appearances in hernial sacs will now be considered, and may be arranged under four heads:—

1. Peculiarities of the sac caused by parts outside of it.
2. Peculiarities of the sac from unequal yielding of its walls.
3. Peculiarities of the sac depending on its partial or total obliteration.
4. Several sacs by the same or by different openings.

(1.) The sac itself may be uniform in outline, but may be held down by bands crossing over it, and may thus have the appearance of being embossed. An instance of this is given in Fig. 7, which is taken from Hesselbach, who found a femoral hernia divided into five partitions by the dilated meshes of the cribriform fascia. It is not uncommon to find one or two prominences of this kind in femoral herniæ. There is a specimen in the Museum of St. Thomas's Hospital in which a band crosses the sac of a femoral hernia nearly vertically, dividing it into two unequal partitions.

(2.) As a hernia enlarges, the wall of the sac does not always expand equally, but yields in one or more places, whereby bulgings and secondary cavities are formed.

A case came under the author's notice of an inguinal sac having a rounded opening at its lowest part, through which a small protrusion of the lining membrane escaped. In this instance the coverings of the sac appeared to have yielded. These local projections of the sac may, in rare cases, be very numerous. Cloquet found a left inguinal sac in a man, æt. 40, which was embossed all over like a cluster of grapes.[28] Sometimes the sac terminates in two diverticula, which are generally small, but may attain a great length. A dropsical patient, under Aston Key, had two pouches depending from the sac between 7 and 10 inches in length.[29] In this class of cases the cavity is deeply divided by a septum more or less perfect. This septum may have a longitudinal direction

from below upwards, or be placed transversely. These appearances may be found in ordinary sacs, and in those formed by the tunica vaginalis. The mode of formation of the septa is uncertain. A preparation in the College of Surgeons suggests that they may sometimes be produced during the continued dilatation of the sac in the presence of adhesions or false membranes.[30] There are instances in which pouches appear to have been caused by the use of too forcible taxis.[31]

(3.) After the reduction of the contents of a hernia the sac remains unreduced, and, if no further protrusion occurs, may undergo partial, if not total, obliteration. Le Dran observed this behaviour of empty

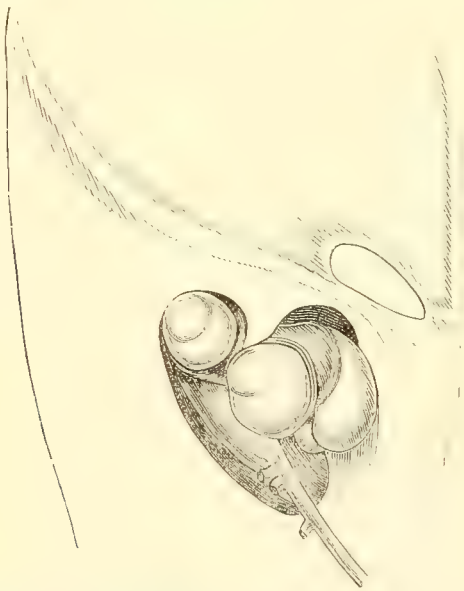

FIG. 7.—A femoral hernia of which the sac is divided into five partitions by bands of the cribriform fascia. (*After Hesselbach.*)

sacs early in the last century, and says that he opened many bodies of those who had kept their ruptures reduced by trusses, and found the entry of the sac very contracted and narrow. He also opened several children who had died of different diseases, and had had ruptures in infancy cured by the use of trusses. In all of them the hernial sac was present, its orifice was contracted, and the cavity still admitted a probe.[32] This tendency of the mouth of the sac to contract under favourable circumstances was of course well known to Hunter, who made use of it to explain a peculiarity which is named the hour-glass contraction of the sac. A constriction divides the sac into two parts, which are in free communication with one another, or are separated by a narrow orifice.

Hunter supposed that the lower half of the sac had formed first, and had been partially obliterated, and that afterwards a second protrusion had pushed before it the old sac, still contracted at the site of its neck.[33] This idea was taken up by later writers, who used it to explain the cases where a succession of dilatations and contractions occur in the length of the sac. It is probable that in many such instances the hernia is really in a portion of the processus vaginalis which has undergone partial obliteration at several places. A constriction in the sac may occur at the external ring, and has been known to lead to fatal consequences. M. Perrin was called upon to reduce a hernia; but, though the bowel returned, he was unable to follow it with his finger along the inguinal canal on account of what seemed to be a narrow external ring. After death a constriction at that level was found in the sac itself, through which the gut had been reduced; but a portion still remained in the inguinal canal between the inner and outer rings, and had suffered strangulation.[34]

The lateral cavities which are found in sacs, and even those exceedingly rare diverticula whose orifices look downwards, have been explained in the same manner. It has been supposed that at first the mouth of the sac has been partly closed, and that then a second protrusion has come down which, instead of driving the old sac in front of it, has passed by, leaving the first sac as a lateral offset.

When the neck of the sac is completely obliterated, the part below may remain collapsed or become the receptacle for another sac. It may also be filled with serous fluid, forming hydrocele of the sac. The protrusion of a new sac into an old one, closed at its mouth, seems to occur more often with femoral than with inguinal herniæ. The best known instance is the preparation in the College of Surgeons, which is figured in Monro's work, where an old sac contains a recent hernial sac, and two or three smaller obsolete sacs at its sides.[35] Less complicated examples of this condition occur not unfrequently in the records of surgery. In a strangulated femoral rupture, which was operated upon by Mr. H. Marsh in 1876, the incision opened a large sac, filled with straw-coloured fluid, into which projected a second sac containing a knuckle of intestine. The walls of both sacs were afterwards found to be continuous with the parietal peritoneum; but the outer sac did not communicate with the abdominal cavity, as it was firmly adherent at its neck to the small hernia which it contained.[36] The sac, after obliteration of its neck, may remain collapsed below, or be filled with serous fluid.

Just as an ancient sac may be below or at the side of a recent one, with which it still communicates, so, when the passage between the two sacs is completely closed, a serous cyst may be found terminating a recent

sac, or placed at one side of it. Le Dran gives a case of right scrotal hernia which was treated and retained by a truss for a month.[37] A swelling of the scrotum still subsisted, which, after several fruitless tappings, was extirpated. There was hydrocele of the sac, encysted hydrocele of the cord, and hydrocele of the tunica vaginalis. The neck of the sac had been completely obliterated in this case; but it sometimes happens that the mouth is occupied by omentum, seldom by gut, which, by adhesions, occlude it.

A very curious instance of hydrocele of the sac was described by Alb. Robin. An old hernial sac, during life, simulated a cyst of the inguinal region. The fluid was absolutely irreducible. No drop of liquid could be made to pass into the abdominal cavity. On dissection a communication was found between the sac and the peritoneum which easily admitted the finger. The orifice was obstructed by a fold of the serous lining of the sac, which formed a valve; and also by a piece of omentum, which floated and plugged the opening whenever the cyst was pressed. Similar cases had been previously described by Houel and Duplay.[38]

Of all the irregularities in the shape of hernial sacs hitherto noticed, by far the most common is a single constriction, which is generally transverse, but may have an oblique or even vertical direction.

(4.) When more than one hernia occurs in the same individual, they do not, as a rule, appear together, but successively. This may be seen in the Statistical Tables at the beginning of the book. It is only in a few of the double ruptures that the two protrusions are contemporary in origin. Among male inguinals, 4.7 per cent. are double at the first onset, and there is no instance among the 20,999 persons comprised in Tables I. and II. of an inguinal and femoral hernia protruded at the same time. When the combination occurs it is generally the inguinal hernia which forms first. Much the most common of all these combinations is that of left inguinal and right femoral.

More rare still is it to find two inguinal herniæ on the same side, and when this takes place they are generally separated by the epigastric artery. Of this an example is presented in Plate IV., which shows an oblique and direct hernia on the left side.

Lastly, a few cases and specimens are preserved of two oblique herniæ on the same side. In Sir Astley Cooper's well-known plate, six herniæ are seen; two external and one internal to the epigastric artery on each side.[39] All these sacs appear to have been occupied, but where two hernial sacs of the same kind exist together, one has generally ceased to contain viscera. Such seems to have been the case in the two following examples. There is a specimen in the College of Surgeons showing two oblique inguinal sacs, one behind the other, of which the anterior seems to be obsolete.[40] The cord was attached at the back of the posterior sac

and lower part of the anterior sac. A similar specimen is found in the Museum of St. Bartholomew's Hospital, but the sacs are side by side and the cord behind both. The inner sac is apparently obsolete.[41] Specimens are occasionally met with in which one sac appears to have become obsolete, and even to have been reduced into the cavity of the abdomen by the growth of a second.[42]

Cloquet asserts that two, or even three, inguinal sacs may be found internal to the epigastric artery. Demeaux possessed a specimen of two femoral herniæ on the left side, one of which was internal, and the other external to the epigastric artery.[43]

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39. **Astley Cooper.**—On Her., Pl. X.
40. R. Coll. Surg. Mus., No. 2616, Bransby Cooper.
Massalini.—Case quoted by Rougemont in Richter on Her., 1799, i. p. 50, in which two sacs of oblique inguinal hernia were placed one behind the other, and were both occupied.
41. St. Barth. Hosp. Mus., No. 2088; also Plate V., Fig. 7, and Plate IX. in Astley Cooper's work.
42. Musée Dupuytren, No. 272.
43. **Demeaux.**—Op. cit., p. 382.

CHAPTER XIV.

CONTENTS OF THE HERNIAL SAC AND THE RELATION BETWEEN THE SAC AND ITS CONTENTS.

Contents of the Hernial Sac.—The viscera which have the freest range of movement are the most common constituents of a hernia, and thus the omentum and ileum, one or both, in the great majority of cases occupy the sac. Arnaud performed 800 operations for hernia, and found omentum in one-third of them; but clinical observation makes it probable that his estimate is too low, and that the majority of herniæ contain omentum.* [1]

The same author, who wrote a considerable treatise on this subject, thought that there is no hernia of the omentum in the very young. The epiploon, according to him, is not found in the fœtus or in tender infancy, and does not begin "to take that fatty consistence which makes its true character" till towards the age of five or six months. "In youth it seldom descends below the level of the umbilicus." The result of more recent observations is in accordance with those of Arnaud. Féré found the omentum high up in the new-born, but in children of one year to fifteen months it was not rarely as low as the pubes.[2] He himself had a case of left inguinal epiplocele in a child aged four years. There is a piece of omentum in the College of Surgeons which occupied the sac of a left inguinal hernia in a female infant aged three months.[3]

Rare in infancy, but common in adult age, the omentum in hernia descends more often on the left side than on the right, owing to the natural inclination of this membrane to the left. In double hernia, whether inguinal or femoral, it is occasionally found on both sides at once. In ordinary cases the small intestine and the epiploon keep the same relation in the hernial sac as they have in the abdominal cavity. Le Dran noticed this simple fact,[4] which has often been lost sight of by writers on hernia, but it is well worthy of attention, for it becomes of the first importance when the surgeon proceeds to the reduction of ruptures. The omentum generally lies in front, and the bowel is added from behind, so that the part which last descended is at the back of the sac; hence every endeavour must be made to return that part first.

Of the other viscera which may enter a hernial sac in the groin, the

* Mr. Bryant in 88 herniotomies found the omentum present in 37.4 per cent. Reichel in 83 herniotomies found the gut only in 45; gut and omentum in 32; omentum only in 6.

jejunum, colon, and cæcum stand next in frequency after the omentum and ileum. Among 417 cases of herniotomy collected by Brunner, the large intestine was found in the sac in 6 per cent., and the cæcum in 2.8 per cent.[5] Among inguinal herniæ in women, the ovary, either alone or in company with other viscera, is found in 1.2 per cent.

Of the remaining organs, nearly all have been met with in herniæ in the groin, the only exceptions being the liver and pancreas. Dr. C. C. Wendt described a case of right inguinal hernia in a woman, æt. 86, which contained the kidney.[6] The spleen was found by Ruysch in the left hernia of a humpbacked woman, who was so deformed that the ensiform cartilage almost touched the pubes.[7] Sir William Lawrence operated on a woman whose gall-bladder had entered the right crural ring. The preparation still shows the groove around its lower end where it suffered constriction.[8] The urinary bladder may escape in several situations.

A rupture may not only contain a part or the whole of the womb, but a fœtus may be developed within it whilst thus displaced.[9] According to Adams, the earliest case of this kind was that of Nicodemus Pol, 1531. After Cæsarian section, the mother lived three days, and the child $1\frac{1}{2}$ years.[10] Among the rarer constituents of a hernial sac is a Meckel's diverticulum, which may be found alone, or an appendix epiploica.*

Besides its legitimate contents, a hernial sac may contain certain loose bodies, which are generally derived from the appendices epiploicæ. They usually present themselves in the form of small oval bodies with a smooth surface, and may have at one extremity a slight depression or trace of a pedicle. They have a nucleus of fatty substance, and are enclosed in a white shining capsule of fibrous tissue, which may give them a very firm consistence. Mr. Canton found one which he was able to move up and down in the sac, but could not return into the abdomen.[11] When the sac was opened, it fell out on the floor, and bounded up like a piece of indiarubber. Deville found two sacs, one on each side, containing one of these bodies apiece.[12] His explanation of their formation has been accepted by several subsequent writers in the Pathological Society's Transactions. In general, the pedicle of the appendix epiploica becomes so attenuated that it breaks, and the body is set free in the abdomen or hernial sac; but in a case of the late Mr. Cooper Forster's, the pedicle gradually lengthened, so that the appendix was found at the bottom of the sac still attached by a cord, $3\frac{1}{2}$ inches in length, to its parent intestine.[13]

* Bayer has recorded a case from Gussenbauer's Klinik of left inguinal hernia in which he found a callous, thickened appendix epiploica, 5 centimetres long, by which a part of the sigmoid flexure had been drawn out into a funnel-shaped diverticulum. (Centr. f. Chir., 1886, No. 40, p. 689.)

A dermoid cyst has been found loose in a hernial sac.[14] Reichel found in the sac of a strangulated hernia two hydatids along with the gut. The woman, æt. 47, was suffering from hydatid of the liver.

Large Herniæ.—A hernia of large dimensions contains many organs, so that the small intestines and omentum, the colon, cæcum, and part of the stomach may descend into the sac.* Besides their change of position, the viscera in such cases undergo various changes from dragging. The stomach becomes altered in shape, bilobed, the part, which enters the sac, being separated by a constriction from that which remains in the belly. A good instance of this is preserved in the Musée Dupuytren.[15] The stomach is much elongated, and is narrowed at the level of the neck of the sac; the part within is 12 centimetres, and that without the sac is 25 centimetres in length. The common bile duct has been noticed to be very much lengthened, and in one case was so wide as to admit a middle-sized finger.[16]

Relation between the Sac and the Parts within it.—The serous membrane, which forms the hernial sac and invests the parts contained in it, is subject to inflammation, which differs not essentially from that which attacks the general peritoneum or the pleura. In hernia the process is usually local and of no great severity, but it merits, and has long received, the closest attention on account of the adhesions to which it gives rise and from which may proceed such fatal consequences.

Adhesions.—The soft lymph at first effused may become absorbed and leave no ill behind it, or it may be developed into organised connective tissue, whose consistence may vary from that of a delicate thread to that of a fibrous tissue so dense as to resemble cartilage.

Looking to these differences in the conduct of the effusion, Arnaud arranged adhesions under three classes: (1) agglutination; (2) the fibrous; and (3) the fleshy adhesion.†

The first consists of soft unorganised lymph, which may be broken through with the finger, and by means of which the contents may be glued to one another or to the sac wall, or the inner surfaces of the empty sac caused to adhere together.

The "fibrous adhesion" may occur in the form of one or many delicate threads, or as firm, fibrous cords, sometimes of great density, or as flattened or rounded bands. A beautiful illustration of this adhesion is given in Scarpa's work, where a stream of fine threads appears to descend from a loop of intestine to the bottom of a hernial sac.[17] By

* Stoll saw the fundus and left part of the stomach in the ring. M. Schmidt found in a "colossal" scrotal hernia the middle two-fourths of the much-dilated stomach, together with other viscera. (Berl. klin. Wochenschr., 1885, No. 1, p. 10.)

† Arnaud added a fourth, the spongy adhesion, which it is not necessary to consider here, as he intended by it the adhesion of new growths. (Dissert. on Her., by G. Arnaud, trans., 1748, London, p. 274.)

a single cord the omentum sometimes adheres to the bottom or sides of the sac, and is elsewhere free. This cord may be several inches in length, so as to permit the reduction of the parts to which it is fixed. On the other hand, the adhesion may take the form of bands passing from one part of the sac to another. An example of this is given in Sir Astley Cooper's fifth plate.[18] A band, forked at each extremity, crosses transversely the lower part of the sac.* In describing this preparation, Sir Astley Cooper explains the mode of formation of these bands by supposing that the walls of the empty sac are united by recent lymph; and that if a protrusion of viscera then takes place, the adhesion may be stretched without being severed. Thus by repeated protrusions the uniting medium is drawn out into a thread or band.[20]

One of these bands has been found crossing the mouth of the sac, and placed obliquely like a valve, so as to make reduction impossible.[21] In another instance a loop attached by each extremity to the mouth of the sac has constricted some coils of intestine, and has been returned with them to the abdominal cavity, still holding them in its grasp.[22] In a still more remarkable case the adhesion appears to have been moulded by the neck of the sac into a circle through which the intestine descended. As a result of taxis, the intestine was returned into the abdomen along with and still embraced by the circular cord, which was itself free from all attachment.[23]

The "fleshy adhesion," as Arnaud seems to have understood it, differs from the filamentous only in being more general. The parts under these conditions may be so closely united that they can scarcely be separated by dissection. The adhesions in a hernial sac may connect the contents to the sac or to one another. In the first case reduction is not possible, in the second it often is.

Adhesions occur far more frequently between the omentum and other parts than between the bowel and neighbouring parts. They are more common at the fundus than at the neck of the sac, and when in the latter situation reduction of the whole protruded portion is impossible. Adhesion between the bowel and sac is rare, except in cases of strangulation. Occasionally the omentum is so universally adherent to the sac, and becomes so closely incorporated with it, that almost all trace of distinction between the two is lost.[24] The same thing may happen, but less often, in entero-epiplocele, and the sac, containing the viscera, becomes completely shut off from the peritoneal cavity.[25] The omentum may adhere at two points to the sac, leaving a space between itself and the wall of the sac, through which a piece of intestine may pass and become strangulated.[26]

* In a case related by Pasturad a loop of gut passed behind a band, like that described in the text, and was strangulated.[19]

When Arnaud spoke of the fleshy adhesion, it may be that he had in his mind the kind of attachment by which the cæcum may be fixed in a hernial sac; but he did not expressly state this, and has left it for Scarpa to complete the description. Scarpa divides the fleshy adhesion into the natural and the unnatural adhesion. The second of these is the kind of adhesion which has been last under consideration. By the natural fleshy adhesion Scarpa meant the attachment of the cæcum or sigmoid flexure to the hernial sac.[27]

The Natural Fleshy Adhesion.

Hernia of the Cæcum.—It is not possible to explain the relation of the cæcum and sigmoid flexure to the hernial sac without making some brief reference to the history of the development of the great bowel.

In the early stages of its growth the cæcum, like the small gut, is without the abdominal cavity, and has, in common with the small intestines, a complete mesentery, which is attached along the front of the spine. It is not unimportant to note that in the primitive bowel there is not that difference in calibre between the two portions which afterwards becomes so distinctive. As growth advances, the intestines retire within the belly,* and the cæcum is at first near the umbilical opening in the middle line. The small intestines occupy the right side of the abdomen, and grow downwards and to the left. Perhaps, in obedience to an impulse thus imparted to it (Lockwood), the cæcum makes a circuit around the abdominal cavity, proceeding first upwards to the left end of the stomach, thence across the middle line above and anterior to the small intestine, and lastly, downwards to its final resting-place in the right iliac fossa. During the period in which these movements are taking place, the colon possesses a complete and ample mesentery. When it has reached its permanent situation the vertical parts of the colon become partly denuded of peritoneum at their posterior surfaces, and are attached by the subperitoneal tissue to the back of the abdomen. This comes about either because the growth of the bowel outruns that of its serous covering, or, as Luschka thought, because the lateral walls of the abdomen, as they enlarge, carry with them a part of the peritoneum from off the ascending and descending colons. The sigmoid flexure, which does not leave the precincts of the abdominal cavity with the rest of the intestines, forms a large loop in the fœtus, and has a considerable mesentery. It may keep throughout life its loose attachment to the iliac fossa, and the free mobility, with which it is endowed, accounts for its frequent presence in a hernial sac. The cæcum also, though occupying its normal position, may be freely movable within a wide range, on account of the persistence of the ascending meso-colon.

* About the tenth week of fœtal life.

During any part of its progress the cæcum may be arrested, and keep permanently one or other of those positions which it has been seen to occupy in the course of its development.* These alterations of place are only so far important here that, firstly, an ascending colon which has not reached the right flank is still generally provided with a mesentery, often with a mesentery common to it and the small intestines,[28] and its cæcum has then a free range of movement; secondly, that the cæcum in these cases does not always attain its due magnitude.[29] Under these circumstances, on account of its free mobility, the cæcum may enter, not only a right, but a left hernia, and when under its usual size, will find entrance more readily.

In the early fœtus the descending colon has a median position at the lower part of the abdomen. When the loop of the sigmoid flexure forms, it lies across the middle line with the convexity upwards and to the right. This condition may be present at birth, and the loop may even reach as high as the transverse part of the duodenum. As it sinks downwards towards its ordinary position, it may deviate to the right iliac fossa, where it has frequently been found, and where it has the opportunity of entering hernial sacs on that side.[30]

Mr. Treves has observed that when subject to distension the sigmoid flexure occupies at first the right iliac fossa, and thence proceeds upwards and to the right.[31] The increase in length, and consequently in mobility, given to the large intestine by distension has been also alluded to by Mr. Lockwood when referring to the observations of Esquirol on this subject.† [32]

The presence of the cæcum or sigmoid flexure in hernial sacs of opposite sides or of the same side has thus been accounted for in three ways; either by change of position of the bowel, or by unusual length of its peritoneal attachments due to defects in development, or by a combination of these conditions produced by distension. It is difficult to determine to what extent the last cause predisposes to hernia of these organs.

There are still two other agencies by which the cæcum may be brought into a hernial sac. In an ordinary hernia containing part of the ileum, if more small bowel descends, it may drag the cæcum and ascending colon after it. This will take place all the more readily if any of the before-mentioned anomalies are present; but there is no reason for

* This is thought to be sometimes due to the adhesions of fœtal peritonitis.

Scarpa thought it not improbable that fœcal distension might assist the descent of the cæcum (*op. cit.*, p. 202). Dr. Gee related the case in vol. xx. of St. Bartholomew's Hosp. Reports, p. 21, of a small boy who was subject to habitual constipation, apparently due to spasm of the rectum. A lump was felt in the right iliac fossa. After death this was found to be an intestinal concretion lodged in the sigmoid flexure, which was enormously distended and lying across the hypogastrium.

supposing that it does not occur even when the ascending colon is fixed in the usual way in its usual place. The second agency is that which produces congenital hernia of the cæcum.

Congenital Hernia of the Cæcum.—The peritoneal fold, which includes the spermatic vessels in the embryo, and at a certain stage of development connects the testis with the cæcum, appendix vermiformis, and ileum on the right side, and the sigmoid flexure on the left, has already been mentioned as having been described by Lobstein, and applied by Wrisberg to explain the descent of these viscera into the processus vaginalis in the wake of the testicle. Scarpa accepted this theory of congenital cæcal hernia, and a little later Meckel compared the migration of the colon to that of the testis. He calls it merely a repetition of the process, and notices that it only occurs in inguinal hernia. The oft-quoted observation of Serres, whereby he associated the descent of the cæcum within the abdomen with the descent of the testis, was another step in the history of this hernia.

But it was not till after the recognition of the smooth muscular fibres in the gubernaculum that the full significance of Wrisberg's theory could be comprehended. In commenting upon this discovery, the illustrious Donders anticipated that important results would flow from it, and further investigation of the gubernaculum has justified his opinion by providing an explanation of the mode of formation of congenital cæcal hernia.[33]

The following brief account of the process is principally derived from the writings of Mr. C. B. Lockwood. Like infantile hernia, congenital hernia of the cæcum differs from others in this, that it appears to depend, not as so many do, on a defect of development, but rather on an excess in that direction.

The muscular structure and attachments of the gubernaculum testis have already been described, and it is only necessary to recall here that at a certain period the lower part ends over the perinæum, tuber ischii, and scrotum; and that above the testis its smooth muscular fibres, together with the spermatic vessels and vas deferens, ascend under cover of a serous fold (plica vascularis) to the peritoneum, which lines the posterior wall of the abdomen. Here the chief part of the unstriped muscle passes to the mesentery, which in fœtal life is common to the cæcum and adjacent ileum. On the left side it ends under the sigmoid flexure. After birth the fold disappears, but some of the smooth muscle of the plica vascularis persists as the internal cremaster. In congenital cæcal hernia the peritoneal fold (plica vascularis) is generally still present, together with an unusual amount of unstriped muscle, distributed on the posterior wall of the sac, and extending from the testis upwards to the cæcum.

If the peritoneal fold (plica vascularis) were always found in these cases, it might be pleaded, with Wrisberg, that this is sufficient to draw down the cæcum after the testicle; but Mr. Lockwood has met with one, if not more than one case, where the plica vascularis had entirely disappeared. All that remained was a quantity of unstriped muscle arranged in the manner above described. Therefore he concluded that the peritoneal fold is not essential, but that the smooth muscle is essential for the drawing down of the cæcum or sigmoid flexure. And when this happens, the smooth muscle is in greater abundance than usual. The peritoneum of the sac is derived from that lining the iliac fossa and back wall of the abdomen, which, unlike that on the anterior abdominal wall, is loosely connected to the parts beneath.

The relation of the bowel to the sac, which brings us back to the natural fleshy adhesion of Scarpa, will be best explained by reference to a case detailed by Professors Bennett and Cunningham, who, by means of transverse sections of a frozen body, have been able to demonstrate very clearly and beautifully the connections of the parts in this hernia.[34]

The subject was a powerful male with a right scrotal hernia, containing in front the lower part of the ileum arranged around its mesentery, which occupied the middle of the protrusion. At the outer and back part of the sac was the cæcum, vermiform appendix, and part of the ascending colon. The sections commenced at the level of the anterior superior iliac spine, and the others followed in downward succession. Within the abdomen "the ascending colon was included between the widely separated layers of peritoneum constituting the root of the mesentery," so that in this situation it had no immediate peritoneal covering, but lay in soft fat.

In the hernia the great intestine was closely applied to the outer wall of the sac. It was evident that a considerable displacement of the peritoneum in the abdomen had been occasioned by the descent of the bowel. The right ureter, which is closely attached to the peritoneum, had been carried some distance forwards from its usual position, and the root of the mesentery had itself glided downwards as far as $1\frac{1}{2}$ inches below the level of the external inguinal ring. On this account the sac was seen to be imperfect at the outer and back part, where the mesentery, and through it the bowel, was directly attached to the scrotal wall.

In the section through the neck of the sac a band of involuntary muscular tissue * was found upon the outer and posterior aspect of the great intestine, which could not be traced downwards, but passed upwards on the back of the colon as high as the lumbar region. During its course upwards it spread out into a layer of muscular tissue, which

* It has not been deemed necessary in this context to describe a closed serous sac found at the back of the hernia in intimate relation with the smooth muscular layer.

at the level of the iliac crest was 2½ inches wide. Here it invested one-half of the circumference of the bowel. The authors have likened it to the platysma myoides, but it was pale. As the root of the mesentery had entered the sac, this was incomplete at the outer and back part down to 1½ inches below the external ring; but below that level the sac was apparently completely lined by peritoneum. The testicle was at the bottom of the sac, with its outer surface downwards; its inner surface looked upwards into the sac, and was covered by serous membrane, whilst the outer side was not. The testicle, say the authors, was "somewhat wasted," but it was probably imperfectly developed. The plica vascularis was absent. The vas deferens and spermatic vessels were near together at the back of the neck of the sac, with the vas to the inner side, but lower down they were widely separated.

This case gives an excellent illustration of Scarpa's natural fleshy adhesion, which he defined as "that formed by the natural ligaments connecting the intestine, before its descent into the scrotum, with the great sac of the peritoneum in the cavity of the abdomen." "These natural ligaments," he says, "slide, to use the expression, along with the intestine from the cavity of the abdomen through the inguinal canal into the scrotum."

It is evident that the presence of this adhesion will depend upon the depth to which the cæcum, or sigmoid flexure, has descended in the sac. It is, therefore, more likely to be found in large herniæ than in small, and will chiefly occur in congenital cæcal hernia, and that form in which the cæcum has been dragged down by a previous enterocele.

Scarpa has described the different states of cæcal hernia with his usual felicity, and it will not be unprofitable to quote from his account some of the most important passages.[35]

In his first case "the tumour only contained the bottom of the cæcum, and therefore he found that the points of attachment of this intestine with the great sac of the peritoneum had only descended about an inch in the vicinity of the inguinal ring from the right ileo lumbar region. On which account the bottom of the cæcum was quite free and movable in every direction within the hernial sac, and allowed it to be returned completely without difficulty into the cavity of the abdomen. . . . In the body of another man, the cæcum, with the appendix vermiformis and the beginning of the colon, had descended lower into the scrotum than in the subject of the preceding observation. . . . In this subject, on trying to push the cæcum, with the beginning of the colon, into the abdomen, I did not succeed completely, because, as I have mentioned a little before, the cæcum, with its appendix vermiformis, was kept there by its natural union with the hernial sac for the space of 2 inches below the inguinal ring." In the third case, a large scrotal hernia in an old man contained the cæcum, vermiform appendix, the beginning of the colon, and extremity of the ileum. "That portion of the bottom of the cæcum, which in the natural state, even within the abdomen, is movable and free from attachment to the

great sac of the peritoneum, in the hernia likewise allowed itself to be raised and pushed upwards towards the inguinal ring ; but the upper part of that intestine and the beginning of the colon remained so firmly tied to the hernial sac, and for so great a space, that it was impossible to make them return into the abdomen."

Thus it is manifest that Scarpa was well aware that the cæcum itself is free in the peritoneal cavity, but he did not ascertain to what extent that viscus is covered by peritoneum. When the cæcum and ascending colon enter a hernia, they appear sometimes to undergo a partial rotation, so that the back of the colon is found at the outer and front part of the tumour.

In the dead body of a man, Scarpa found that "the viscera, descended into the scrotum, had turned round their axis, so that their union with the hernial ac had been carried from the posterior to the anterior surface of the tumour, in consequence of which I found it impossible to discover the hernial sac, until I again made an incision into the hernia towards the inner side of the tumour. This combination is what, in my opinion, has led the young surgeon, Sernin, into an error with regard to this hernia. For he mentions that in practising surgical operations on the dead body, he undertook the operation of scrotal hernia on a subject which opportunely presented a tumour of this species in the right side of the scrotum." After dividing the tissues without finding a hernial sac, he "finally succeeded in discovering the intestine, and found that it was the cæcum with the extremity of the ileum, and the beginning of the colon, but denuded and entirely unprovided with hernial sac. From this he concluded that hernia sometimes forms in the scrotum without (outside) the sac of the peritoneum, and consequently without a hernial sac, to which he gave the name of entèrocéles akystiques." In speaking of this error, Scarpa observes "that it ought not to excite surprise that a young surgeon should be deceived with regard to the nature of this disease, since we now know that the same mistake was committed by two celebrated masters of the profession, Desault and Chopart, who said, openly, that they had seen the cæcum denuded under the integuments of the scrotum."

I have quoted thus extensively from Scarpa to show whence arose that error regarding the covering of the cæcum which sank so deep into the minds of the text-book writers of this century.* Notwithstanding the refutation of the error by Scarpa, it still held its ground, and we find Baron Boyer in 1822 again calling attention to it.[36] He gave the cæcum a more extensive attachment than it naturally possesses, but he remarks, "Surgeons have been in error who have said that herniæ of the cæcum or colon are without a peritoneal sac, and this error is all the more easily made, as sometimes in operations the part presented to the surgeon is the adherent part."

But the old opinion of the coverings of the cæcum was still maintained,

* Mr. Treves has traced the error through a great variety of text-books.

and in the report on the examination of Sir Astley Cooper's body in 1841, the fact is noted with some surprise that "the cæcum was completely invested by the peritoneum, and was hence less fixed than usual."[37] It was not till 1849 that Bardeleben published his essay on the position of the cæcum in man, and demonstrated the absurdity of the statement that cæcal hernia is without a peritoneal sac.[38] When preparing the peritoneum for Bischoff's Lectures on Anatomy, Bardeleben had been accustomed to take the serous sac out of the abdomen intact, in order to show what parts were not covered by peritoneum. When he published his paper, he had examined the cæcum in 160 bodies in this way, as well as from the interior of the abdomen, and came to the following conclusion. "The cæcum, that is, the part below the ileo-cæcal valve, is, as a rule, surrounded completely by peritoneum, possesses a short mesentery, and lies so freely movable in the belly that it can be raised upwards and moved from side to side. The cæcum is never placed outside the peritoneum in the way described, and cæcal hernia always possesses a peritoneal sac." Moreover, he points out that a perityphlitis cannot occur till the cæcum first becomes adherent to the underlying peritoneum.

Again, Engel, in 1857, says that he found the cæcum extending towards the symphysis pubis in 30 per cent. of bodies, and the lengthened piece is always enclosed in its whole circumference by peritoneum. "Hernia in which the cæcum is contained will therefore also always possess a sac."[39]

Luschka, in 1862, found the old error still so prevalent in the surgical and anatomical writings of the day, that though, he says, it had been repeatedly pointed out before, he went over the whole ground again, and established not only the necessity of the ordinary occurrence of a peritoneal sac in cæcal hernia, but also the impossibility of a perityphlitis understood in the usual sense.[40] Mr. Treves within the last few years has examined once more the coverings of the cæcum, and has verified the conclusions of the writers above mentioned.

The cæcum in a hernia will possess a perfect sac on the left side always, and on the right side almost always,* so long as the cæcum alone descends. When the ascending colon enters the hernia, it will sometimes happen that the sac will be imperfect at the back where the colon has no serous covering. But only sometimes, for the ascending colon often has a mesentery. It is, therefore, manifest that the natural

* In very exceptional instances the cæcum, completely denuded of peritoneum, occupies a hernial sac on the right side. H. Braun, Berl. klin. Wochensch., Jan. 24, 1881, p. 47; W. H. Bennett, Med. Chir. Trans., 1890, vol. lxxiv., p. 129; Tuffier, Arch. Gén. de Méd., 7th ser., vol. xx., p. 59, 1887; G. Buzzachi, Cent. f. Chir., 1876, No. 18, p. 288, a case of right femoral.

fleshy adhesion of cæcal hernia will be rarely met with. Of the five modes in which it has been shown that this hernia may be produced, the three first will almost invariably result in a hernia with a perfect peritoneal sac. The herniæ proceeding from the two last modes will often have a perfect sac, and only in a certain proportion of these cases will the colon sink low enough to be without peritoneum at the back. Therefore cæcal hernia, like all intestinal herniæ, is generally reducible. A circumstance may here be mentioned which, in a solitary instance at least, may have caused displacement of the cæcum. Blazina found that viscus, with part of the ascending colon, so far displaced to the left that a loop of the lowest part of the ileum, scarcely 2 inches from the valve, was in a left inguinal sac. This movement of the cæcum was thought to have been caused by the contraction of a false membrane, only a few lines thick, attached to the great bowel.[41] It may be, however, that the cæcum changed its place before the formation of the false membrane. Inasmuch as hernia of the cæcum has no clinical importance beyond the matters already referred to, it will be convenient to conclude here what remains to be said of this hernia, and of that of the appendix vermiformis and sigmoid flexure.

It is not possible to diagnose cæcal hernia except where the coverings are very thin, and the appendix can be felt through the integuments. Mr. Treves detected a cæcum in a right femoral hernia in this way,[42] and the author has met with a right femoral in a woman, æt. 28, at the Truss Society, in whom the appendix could be easily felt through the skin. But this is quite unusual, and the presence of the cæcum is only revealed, as a rule, by the surgeon's or anatomist's knife.

Of 51 cases of hernia of the cæcum collected by the author, the distribution was as follows :—

Right Inguinal.	Right Femoral.	Left Inguinal.	Left Femoral.
36	5	9	1

The left femoral occurred in a woman who came to the Truss Society in 1891, and who was afterwards operated upon at St. Bartholomew's Hospital by my colleague, Mr. Langton, who found the cæcum in the sac. So far as a small number of cases can give assurance, it seems that this hernia is not limited to one sex, or to any one age.

The position of parts in the sac will be usually with the omentum in front, the small intestines beneath the omentum, and the cæcum at the back and outer side. In large herniæ the contents do not always preserve the normal relation, for the omentum may be drawn to one side, and, as before observed, the cæcum may occasionally undergo rotation, so that it presents in front and at the outer side.

Hernia of the cæcum is mentioned so far back as 1559 by Rossetus,

who saw Maupasius perform herniotomy on a bootmaker and expose this part of the great intestine.[43] In 1631 Malachias Geiger said that it commonly occurs on the right side, and refers, for the first description of it, to Galen.[44] Spigelius saw the whole cæcum, with part of the colon and ileum, in the scrotum of a man hung at Padua.[45] A little later Blegny speaks of it as undoubtedly occurring, but yet very seldom;[46] and after him it was well known, being frequently mentioned by writers in the last century.

Hernia of the Appendix Vermiformis.

The appendix vermiformis is sometimes the sole occupant of an inguinal or femoral sac on the right side. In such cases it may be much larger than normal, and be three or four times its ordinary size.[47] It may be free in the cavity, or attached by a small mesentery to the wall of the sac, or may be connected with it by adventitious adhesions. Its union with the sac may be so close as entirely to obliterate that cavity;[48] or the cæcum may rest against the mouth, become adherent there, and shut off the sac from the abdominal cavity.[49]

Luschka observed a case in which the vermiform appendix, possessing a small mesentery, formed a rounded packet, and was the sole contents of a femoral hernia.[50] Cloquet found in an old man an inguinal sac with a narrow transverse constriction, through which the appendix passed to be attached to the fundus. The end of the cæcum, apparently dragged by the appendix, had a conical form, and was near the mouth of the sac.[51]

Hernia of the Sigmoid Flexure.—Of hernia of the sigmoid flexure two circumstances may here be noted. Firstly, this part of the bowel may form a congenital hernia on the left side, just as a congenital cæcocele may occur on the right.[52] Secondly, it has happened in rare instances that when the sigmoid flexure has entered a sac on the right side, it has been subject to a volvulus which has proved fatal.[53]

A case of this kind in an old man is reported by Lassus.[54] The operation for strangulation was performed on the fifth day for a right scrotal hernia. The ring was found free, and though it was further enlarged, reduction was impossible. The sigmoid flexure crossed the lower part of the abdomen from left to right, and was twisted on itself opposite to the linea alba. Death was due to peritonitis. It was not clear, even after death, why reduction was so difficult. This same circumstance was noted by Pelletan in his case, which is almost identical. The presence of the sigmoid flexure in the sac can hardly be detected during life, unless the surgeon can feel the appendices epiploicæ through the sac wall, and can distinguish them from omentum. In describing a

case of strangulated inguinal hernia containing this portion of bowel, M. Berard (aîné) gave, as a pathognomonic sign, the impossibility of charging the rectum with more than some ounces of liquid.[55]

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CHAPTER XV.

CHANGES IN THE PARTS CONTAINED IN THE SAC.

Changes in the Parts contained in the Sac.—The subject of the present chapter has been to some extent anticipated in considering the relation of the sac to its contents, but the changes in the position and in the structure of the parts contained still remain to be described.

Changes in Position of the Omentum.—As regards the changes in position, it has already been remarked that in large herniæ the omentum may be drawn to one side instead of being in front of the intestines. It presents occasionally another peculiarity, for a coil of intestine may pass through a thin spot in the omentum and appear anterior to it. Several such cases were described by Scarpa, who thought that the intestine was driven through the omentum during some violent expulsive effort.[1] The tissue may become thickened about the rent and form a ring, which may give rise to strangulation of the bowel.

Changes in Position of the Intestine.—Another and very exceptional position of the parts in the sac, though sufficiently well known when occurring within the abdomen, is that in which the bowel makes one or more turns around the omentum, which has been formed into a cord and fixed by adhesion. The late Mr. Callender recorded a case of this kind in which the bowel was returned without difficulty during the operation, and the omentum, which was adherent to the sac at the lower part, was left undisturbed. After death the intestine was found to have taken one and a half turns around the omentum, and to have been thus occluded.[2]

Nearly allied to this change of position is that in which the intestine turns on its axis. Within the abdomen this is well known as one of the causes of internal strangulation, but it may also be found in hernia. Linhart records a case of femoral hernia in which a twisting of the loop about its axis was discovered when the bowel was drawn down during herniotomy.[3]

Changes in the Structure of the Omentum.—The changes in the structure of the omentum may be taken next, and it may be observed that this tissue is oftentimes protruded without suffering any appreciable change. But a residence in the sac for any length of time alters its character in various ways. It may take the form of a cord, not from actual twisting, but from a crowding together of its parts in a transverse

direction. Hey gives two observations of this anomaly, and it is mentioned by many others.

The omentum may be matted together in a lump, so as to be shortened, and in consequence of its altered shape may be irreducible. In such cases the colon and stomach are not only drawn down towards the mouth of the sac, but are also fixed in that position. The displacement of the stomach produced in this way, or by simple adhesion of the omentum to the sac wall, has been thought to give rise to grave inconveniences. M. Guerin met with a case, which is quoted by Macfarlane,[4] in which herniotomy was performed, and a portion of gangrenous omentum was removed. The stump was left, and became adherent to the sac. The patient recovered, but continued to vomit after every meal. He was at last reduced to the necessity of eating in bed with his legs drawn up to the abdomen, in order, it was supposed, to relax the omentum and lessen the pull upon the stomach. The same author quotes similar instances, in some of which the displacement of the stomach was verified after death, but such symptoms accompanying irreducible omentum, even when the greater part of it is in the sac, are quite exceptional, and cannot be regarded as the ordinary effects of this condition.

Omental Sacs.—The omentum is sometimes so arranged and so adherent that it forms a cavity which may contain intestine and cause strangulation of it.[5] This anomaly engaged the attention of the late Sir Prescott Hewitt, who wrote two papers upon the subject.[6] He describes one of his cases in which the omentum in the hernial sac was in size and shape like a pear. It was closely adherent to the sac, and at the upper part, where it was but little thickened, it was thrown into folds, in the midst of which was a well-formed pouch. At the abdominal entrance to this pouch the folds were united to each other so as to form a complete ring. Colles remarked on this anomaly, that a small piece of intestine may continue to be tightly girt by the omentum after it has been returned to the belly, and a surgeon of the present day has had the misfortune to cut off one of these omental sacs, which contained at the time a portion of bowel.[7] The mouth of these cavities is sometimes completely closed, and a dark fluid is contained within.* [8]

Loss of Fat in the Omentum.—The omentum in a hernial sac very commonly loses fat and becomes fibrous and pale. This is especially noticeable at the neck of the sac, where it is most exposed to pressure, in consequence of which it is often reduced to a thin cord. The dis-

* Kirmisson describes a hernia in two parts superposed. The omentum in each part was arranged in the form of a cyst, the walls of which were so thick that neither cyst was translucent. These cysts were completely shut off from the abdominal cavity, but space was left behind the omentum at the neck of the sac for the bowel to descend.[9]

proportion thus arising between the part in the fundus and the part in the neck is one of the most frequent causes of irreducibility. The omentum may form a layer, fixed to the front wall of the sac, an inch or more in thickness; hardened, as Pott said, into a flat cake, and as "incompressible as cold beeswax." It may have a marbled aspect on section, or may be quite homogeneous.

In cases of omental hernia fluid is sometimes present in the sac. Its amount is not generally considerable, but it may be in such large quantity as to constitute "an additional disease to the original one."[10]

Calcareous Degeneration of Omentum.—The changes already noticed in the omentum may at length terminate in calcareous degeneration. Arnaud gives an extraordinary instance of this peculiarity, and of its effects.[11] A nobleman of Provence, æt. 50, had an irreducible omental hernia, which was so hard that he suffered much pain when the cremaster drew up the testicle against the lower end. He submitted to operation on this account, and lost his life. The omentum had no fat. Its surface was covered with little stony concretions of irregular shape, like grains of sand. The lower part of the mass was of the size of the fist, almost round, and as hard as a stone. On section it was found to be filled with sandy concretions like those on the surface. Its substance appeared to be made up of different "gypseous and stony parts," of which the largest had the shape, size, and consistence of cherry stones. The smallest were like grains of wheat. "All these concretions were held together by a thready and elastic substance." The omentum generally was studded with these solid bodies.

The omentum in a hernia sometimes gains fat, and though this generally happens in fat persons, it has also been observed to occur in thin ones. Arnaud found a mass of omentum in a hernia weighing four pounds. This increase of bulk is another cause of irreducibility in epiploceles. The fat may be developed in a mass so circumscribed as to constitute a lipoma. Like the other viscera, the omentum in the sac is liable to inflammation, which may end in abscess. It has even in some cases become gangrenous, and this, it would seem, independently of strangulation.

Lastly, the omentum may become cystic, or be the seat of new growth. The cysts, which in former times were called hydatids,[12] are now thought to be due to inflammation, whereby the omentum becomes agglutinated and fluid is poured out in the intercepted spaces.[13] A case of the kind has been referred to in the note on page 112. The omentum in the hernial sac may also be affected with sarcoma, carcinoma,[14] or tubercle. When tubercle occurs in the omentum, the sac also is sometimes implicated.[15]

Changes of Structure of the Intestine.—It has already been observed

that the intestine in a hernial sac forms adhesions much less often than the omentum; not that the gut is less liable than the other to inflammation, but that the bowel is more easily reducible, and that the discomforts arising from protruded bowel are much greater than those from protruded omentum, and therefore much more care is taken to keep the intestine within its proper cavity.

The intestines, however, are in some cases adherent to the sac, or, though free in that cavity, the coils themselves may be matted together. This condition may prevent reduction, though not invariably.[16] There is a specimen in the Museum of Guy's Hospital showing several coils of jejunum, taken from a reducible rupture, agglutinated in one mass.[17] This adhesion of the bowel to itself may become so close as to interrupt the passage of the intestinal contents.* [18]

No alteration occurs in an intestine which only descends occasionally into a hernial sac; and though it is found there sometimes thickened, and, if Meckel is correct, redder than normal, these changes are not constant, but the result of habitual residence. A circular impression or groove is sometimes found around a loop of bowel which has long been in a sac, though the part has never suffered strangulation.

The occasional thickening of the wall of the gut contained in a hernial sac has often been noticed,[19] and may be very considerable. Meckel found it increased threefold, and in Brooke's case it was $\frac{3}{4}$ of an inch thick. The bowel, thus altered, has been carefully examined by Mr. Holmes and Mr. Brooke, and both these observers found the mucous and serous coats apparently unchanged, but the muscular tissue greatly hypertrophied. Meckel supposed that the muscular coat underwent development, because more force would be needed to drive the contents through the gut when it is enclosed within the narrow limits of the hernial sac. In Mr. Holmes' case and Mr. Brooke's a truss had probably pressed upon the protruded intestine, but that such artificial means is not needed to produce the hypertrophy is shown by Pelletan's case. His patient had never worn a truss, and the bowel was 6 lines thick. The size of the bowel may be so much increased by hypertrophy of the muscular coat that it becomes irreducible, though no adhesions whatever are present. An interesting case of this kind was described by Malassez.[20] The thickening of the wall is generally accompanied by narrowing of the calibre of the bowel, and these two conditions were found together in the majority of the cases quoted below. The stricture appears to be due either to the hypertrophy of the muscular coat alone or to the cicatrix of an ulcer caused by strangulation. In the last case the formation of the cicatrix will precede the hypertrophy.

Several of the cases had some such history as the following. At

* See chap. xxxv. on the effects of strangulation.

some period before the observation was made, varying from seven years to a few weeks, a hernia had become strangulated, and had been returned either by taxis or operation. The symptoms, however, had never quite passed off, but vomiting or constipation, more or less severe, had persisted, till at length death resulted from perforation. All the patients above referred to were elderly, and most of them females. In a case of this type, recorded by M. Nicaise, the strangulation occurred five years before the fatal illness. The man was brought in suffering from obstruction, and died after an operation practised for its relief. The part of the intestine containing the stricture formed a double curve like the letter S. The adjacent sides of the two loops were adherent. Above the constriction, which was just beyond the first bend, the gut was much dilated, and contained a quantity of fruit stones and mutton bones mixed up with the debris of food.[21]

In this context may be mentioned a very rare circumstance somewhat akin to the foregoing, of which the best instance known to the author occurred in the practice of Mr. Birkett.[22] A man, æt. 58, was admitted to Guy's Hospital dying of perforation. Six months previously a right inguinal hernia had been strangulated for thirteen days, and, just when life was despaired of, the parts returned, and he recovered. Mr. Birkett found that a piece of the jejunum had been originally constricted, and that a communication had formed between the two adjacent portions of gut. The strangulated part had become contracted, and by means of the aperture connecting the two pieces of bowel the intestinal contents passed from the upper to the lower section without traversing the loop. The adhesions at the site of the communication had recently given way, and extravasation had occurred.

Partial Enterocele.

There are no words in English, equivalent to the German Darmanhangsbruch and Darmwandbruch, to distinguish the hernia of Meckel's diverticulum from that of a part of the intestinal wall. Partial enterocele, which was one of Richter's terms, implies a limitation from which the German name is free. But, in the absence of a more exact nomenclature, the term partial enterocele will be used here to denote protrusion of part of the intestinal wall.

The first formal notice of this condition is given by Lavater in his Essay on Strangulation in 1672.[23] He classifies his subject in the following manner. First, when the gut alone is strangulated, and when the gut is associated with other viscera; secondly, when the strangulation is slight or severe; thirdly, when there is strangulation of the whole gut, or of a part of it.

In illustration of the last section he quotes the case of Magdalen Hauchet, who had a left bubonocele strangulated. Bienasius, being unable to attend the case, sent Lavater with an assistant. They observed, or thought they observed, some oil, which had been given not long before in an enema, discharged by the mouth. As they failed to reduce the hernia, the patient was left with her head down and her heels in the air till next day, when Bienasius attended and performed herniotomy. During the seven days of strangulation she vomited, but nevertheless passed liquid stools, and Lavater says that the operator found the cause of this to be due to a part only of the intestine being constricted.[24]

Littre observed this condition, in 1714, in a ventral hernia above the umbilicus of a woman who died of strangulation of part of the transverse colon.[25] He had previously, in 1700, described this rupture, but used as illustrations two cases which have been since recognised as herniæ of Meckel's diverticulum. Littre, however, raised the question of their congenital origin, and dismissed it as too improbable. Herniæ of Meckel's diverticulum are called by Professor Albert[26] after Littre, but he was not the first to demonstrate this hernia, nor does he seem to have been aware that diverticula of the intestine can exist independently of hernia.

These diverticula (Meckel's) were known to Ruysch, who delineated the intestine thus affected in 1698, and again later.[27] He says of them that they are "generally met with in the ileum . . . and it may happen that such diverticula may be contained in a hernial tumour without any of those symptoms supervening which accompany inguinal hernia."

Both of these herniæ were known to Morgagni, who in 1741 carefully distinguished between the two, and notes a case of his own in which part of the wall of the ileum was intercepted, and in which fatal strangulation ensued.[28] Therefore to Lavater, Littre, and Morgagni more properly belongs the discovery of the partial protrusion of the intestinal wall, and to Ruysch and Morgagni that of the herniæ of Meckel's diverticulum. Mr. Treves has followed Professor Albert in confining the term "Littre's hernia" to that of Meckel's diverticulum, and (transported, perhaps, by admiration for Richter) has called after his name the herniæ with partial protrusion of the intestine.[29] The only writer of past times who added materially to the knowledge of these conditions, after the surgeons already named, was J. F. Meckel, when he discovered the embryonic origin of the diverticula which bear his name, and settled for ever the difference between these herniæ, which before him had been so often confounded.[30] Richter, on the contrary, has shown a tendency to confuse the diverticula of congenital and accidental origin; he has not kept free from some of the old errors, and has not imparted anything unknown

before. Sharing to the full the admiration for Richter which is felt by those familiar with his writings, I do not find in his discourse on "small herniæ," as he called them, such excellence as would justify disregard of those who preceded him.

Besides the congenital diverticula which are composed of all the coats of the intestine, there are others called false diverticula, in which the mucous membrane protrudes between the fibres of the muscular coat, and forms a projection from the bowel covered by the peritoneum. Concerning the presence of the false diverticula in a hernial sac little is known, but the true diverticula have been found there, as above-mentioned, from time to time. Much more often one side of the bowel is projected into a hernial opening, so that part only of the calibre of the canal is in the sac. If the intestine continues in this position for any length of time, the pouch persists, at least for a season, after the bowel has been set free. Sir Astley Cooper says that he often found these diverticula on the intestine in the bodies of persons who had never suffered from rupture or worn a truss, but it is possible that he mistook the true Meckel's diverticula for the artificial pouches of partial enterocele. These latter are not generally found post-mortem. In the specimens met with in museums and on the operating table a well-defined pouch is seen on the intestine; but these cases, as a rule, represent the effects of recent strangulation, and give no assurance that the pouch would long persist after the release of the bowel.

In two cases in which death occurred from strangulation, an old shrunken pouch was found on the bowel in the abdomen, not far from the recent one; these ancient pouches marked the site of a previous strangulation which in one case was dated ten years back.[31]

Riecke describes a case in which the patient was bed-ridden for nine months before his death. After the first five months the hernia, which had been irreducible, went back, and continued within the abdomen during the remaining four months of life. At the post-mortem a small projection was found on the intestine near the hernial aperture which Riecke regarded as a withered partial enterocele.

Another important observation was lately made by Trzebicky, who exposed one of these pouches when performing herniotomy. Having set the bowel free, he suspended the operation for a quarter of an hour, after which the pouch had so far subsided that the intestine had nearly recovered its normal form.

This scanty evidence is almost all there is which tells the fate of partial enterocele after the return of the bowel to the abdomen, when the patient survives. From it we gather that the pouch tends to become obliterated, and, as in the above cases, either subsides altogether, or remains a mere vestige of its former self. The independent existence of

these diverticula when the bowel has been withdrawn from the hernial sac has been disputed and denied by some of the German surgeons. It is supposed that the bowel, if free from adhesion, takes the form of the sac whilst it is *in situ* and resumes its ordinary shape when released, and that a pouch can only be permanent when it is fixed to the sac by adhesions.* This view has met with some favour in Germany since its first introduction by Röser, but has obtained few adherents in this country or in France.† The adhesions of the bowel to the sac, upon which Professor Röser has so much insisted, are the exception and not the rule in this hernia.

Partial enterocele is probably very frequent, and Meckel goes so far as to say that most enteroceles at their creation are incontestably of this description. There are no means of ascertaining the truth of his conjecture, but we are able to recognise a circumstance which controls their frequency. If we make a comparison of these herniæ, grouped according to their apertures of exit, it is at once perceived that the firmer and more rigid the boundaries of the opening, the more frequent are these diverticula. They are more common in femoral than in inguinal hernia, and the femoral opening is made up of bone and a very firm fibrous tissue more resistant than the abdominal ring. But in obturator hernia the abundance of these diverticula is relatively far greater, and among the cases quoted at the end of the chapter on that subject, 41.5 per cent. were partial enteroceles. The obturator foramen is generally small, and the part not enclosed by bone is formed of fibrous membrane of a peculiarly tough and unyielding character. Dr. Johnstone, who had to incise it during an operation for strangulation, says it felt as sharp and hard as an edge of steel.[32] Therefore it is probable that the origin of these ruptures is related to the size and nature of the ring through which the bowel passes and to the resistance it meets with in its progress.

When Littre described this hernia, he met with two cases in which a Meckel's diverticulum was protruded, but not being aware of the congenital origin of the pouch, he discussed the subject as if he were dealing with a hernia of one side of the intestine. His explanation of its formation may be briefly presented as follows.

He first describes a case occurring in a very muscular man of middle age. Then, given a hernial aperture, the formation of which he explains according to the doctrine then common, he recites all the circumstances which may tend to press the intestine into the sac, and accounts for its

* "A free Darmwandbruch I have not seen, and there is no case known to me in literature." (Benno Schmidt.[32])

† Of the many publications in which Professor Röser has made known his views, that which appeared in the Centr. f. Chir., 1886, No. 24, p. 50, gives, I think, the clearest exposition of them.

partial entry by saying that "the walls of the rings of this very muscular man, having strongly resisted dilatation, had refused entry to the rest of the circumference of the intestine." So that he seems to have contemplated a firm aperture and a small space beyond it as the conditions for the production of this hernia. Professor Kocher appears to explain the formation of these ruptures in much the same way, viz., by the intra-abdominal pressure forcing a part of the bowel through a narrow ring.[34] The intestine is almost invariably pinched at one of the orifices above-named or at the mouth of an umbilical or ventral hernia. But the bowel was quite differently placed in a case given by Aimé Guinard.[35] The tunica vaginalis may remain patent, and just above the testis may contract so as to form a kind of diaphragm pierced by a central opening, which leads from the funicular to the testicular part of the processus. In this central opening Guinard found a portion of the tube of the ileum strangulated, whilst all the funicular part above was packed with small intestine, and formed a tumour the size of a child's head. M. le Saint Germain found in a little diverticulum of a femoral sac a part of the gut which had passed beneath, and was held down by, one of the bands of the cribriform fascia.[36] M. Tuffier met with a partial enterocele in a femoral sac, that formed part of a so-called cruro-properitoneal hernia, in which the main body of the sac lay between the pubes and the parietal peritoneum.[37] The part of the intestine which is intercepted, or "niched into the ring," as Sharp said, is, with few exceptions, the free edge opposite the mesentery. Occasionally it is a part between the mesenteric and free border. In Demarquay's case a portion of the circumference of the bowel was pinched in the femoral ring, and with it an adjacent portion of the mesentery. This mesentery, as well as the bowel, was cut by the sharp edge of Gimbernat's ligament, whereby a large mesenteric vein was opened which bled into the lumen of the gut with fatal consequences.[38]

The affected portion forms a rounded or oval prominence on the surface of the intestine, and is composed of all its coats. At the line where the pouch joins the intestine there is, as a rule, a groove, more or less distinct, which corresponds to the mouth of the hernial sac; and it is evident that the shape of the diverticulum will vary according as it is seen constricted by the margin of the hernial opening or outside the body free from all constraint. The diverticulum may involve a quarter or less of the calibre of the canal or a greater extent, till in some cases the mesenteric border almost touches the mouth of the sac. The coats of the intestine along the groove may be continuous or not, according to the degree of pressure to which they have been subject. When strangulation has occurred the mucous membrane is often ulcerated not only in the line of the groove, but also in the canal above it. Dr.

Goodheart found traces of an old ulcer within the bowel near the site of a recent one.[39]

In M. Brunon's case, M. Cornil was able to demonstrate a division or rupture of the longitudinal muscular fibres, whilst the circular fibres and mucous membrane were not affected.[40] Sometimes omentum accompanies these diverticula, but ordinarily they are alone in the sac, and as the pressure falls entirely on the wall of the gut and is not shared by the mesentery or often by the omentum, its effects are generally severe.[41] Consequently, in a large percentage of cases all the coats have ulcerated at the strictured part, leading to perforation; or the whole pouch has perished from mortification.

The affection is generally discovered late in life, and very seldom is it met with in childhood.[42] Gibson found it in a boy of fourteen, and his case had this singularity, that a few inches above the partial enterocele there was, within the abdomen, a Meckel's diverticulum. Hofman (Wien) found an undoubted instance in the corpse of a child.[43]

Judging from the previous histories of the patients who come under observation on account of strangulation, these herniæ are generally accompanied by attacks of colic and constipation, occasionally by vomiting, and these attacks come suddenly, last perhaps only a few hours, and suddenly pass off, to recur again at uncertain intervals. Some surgeons are of opinion that many partial enteroceles are strangulated at the moment of their first protrusion. When a swelling exists in the inguinal or femoral regions there is no difficulty in connecting it with these disturbances of function; but frequently no tumour can be detected, and the symptoms remain unexplained and sometimes unrelieved. The presence of the symptoms of hernia, to all appearances without the hernia, gives to this affection its principal interest and importance.

Hernia of Meckel's Diverticulum.—Hernia of Meckel's diverticulum, though not properly belonging to the subject of this chapter, may be most conveniently mentioned in the present context.

True diverticula of the intestine are of somewhat rare occurrence, an average of about two being found per 1000 post-mortem examinations.* They must therefore be extremely rare in hernial sacs, for, as Littre observed, it is unlikely that this one spot out of the whole length of intestine should be selected for protrusion. Such cases are indeed seldom recorded, and among those apparently of this nature several are open to doubt. Ruysch supposed that a diverticulum in a hernial sac would not give the ordinary signs of hernia, whilst Littre, and after him Gladbach,[44] gave a list of symptoms by which to distinguish strangulation of

* Dr. Norman Moore found only thirteen of Meckel's diverticula in the medical post-mortem records of St. Bartholomew's Hospital for sixteen years. (Tr. Path. Soc., 1884, xxxv. p. 202.)

a diverticulum from that of the intestine. But cases by later authors have shown that these signs, such as absence of fœcal vomiting, of constipation, and of meteorism, are not constant. In Gaderman's patient,[45] in whom the diverticulum was 4 inches in length, and in two of Riecke's, there was fœcal vomiting, and in these latter also absolute constipation.[46] The amount of obstruction to the passage of alimentary matters must of course depend upon the distance to which the diverticulum is buried in the sac.

Dr. Stretch Dowse found a true Meckel's diverticulum in a direct inguinal sac on the right side in a woman, æt. 77. It had become ulcerated, and a fœcal fistula had formed.[47] Dr. Keeling operated upon a boy $2\frac{1}{2}$ years old who had swallowed, three days before, a quantity of crab shell. The pouch was gangrenous, and contained two teaspoonfuls of fragments of shell. The gangrenous tissue was excised, and the boy ultimately made a good recovery.[48]

Cysts derived from Meckel's Diverticulum.—A rare form of cyst which has been found in hernial sacs, and is probably derived from Meckel's diverticulum, may be here conveniently referred to.

Monro relates a case of Wardrop's, in which he found one of these structures in a sac. The attachment of the diverticulum to the bowel was so narrow that he tied a ligature round its base and cut it off. The cavity appears to have been still in communication with the intestine, but by a very narrow channel.[49] A cyst attached to the ileum was found by Dr. Bennett in the sac of a femoral hernia, which in its form and size appears to have resembled a closed Meckel's diverticulum, but the observer repudiates this mode of origin. Other instances are given by Lejars and Benno Schmidt.[50]

Changes of Structure in the Mesentery.—Besides the changes in the intestine already detailed, it may in very rare instances be affected with tuberculosis,[51] cancer,[52] sarcoma, and perhaps other new growths.* Various changes may occur in the mesentery when it enters the sac with the bowel. If a considerable portion of mesentery is down, reduction is generally rendered more difficult, and sometimes wholly prevented. Like the omentum and intestine, it may become narrower, and receive an impress under the pressure of the neck of the sac, till at length the bowel becomes irreducible from the disproportion between itself and the hernial orifice.† Among other morbid changes of the mesentery are

* Chauffard gives a case of left inguinal containing 20 centimetres of the sigmoid flexure which, together with the wall of the sac, was cancerous. See Lejars, *loc. cit.*, for a good résumé of the subject.

† Chassaignac found this peculiar condition in a left femoral hernia. The mesentery of the irreducible bowel extended as a raised cord from the mouth of the sac to the spine. Over this cord the portion of gut about to enter the sac, the upper portion, had passed from left to right and dropped into the pelvis. It was thus completely obstructed at the part where it turned sharply over the mesenteric ridge.[53]

found large tuberculous glands which have prevented reduction,[54] and Pelletan mentions a hard tumour in it which had the same effect.

Foreign Bodies in the Protruded Intestine.—Hard or irritating substances lodge sometimes in the loop of intestine in a hernia, where they may set up ulceration and suppuration and be found after death, or be removed during life from the cavity of the abscess. Substances of a great many different kinds may occasion these mishaps, and among them the following have been recognised, viz., the skin of apple; orange pips; cherry, plum, grape, and date stones; mutton bones, fish bones, crab shells, a large pin, and a piece of cinder. In a case of this kind Petit found a lark's foot which had been swallowed by a cook in a fit of gluttony.

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CHAPTER XVI.

ON INGUINAL HERNIA.

Oblique and Direct Hernia.—Under the name of inguinal are comprised those herniæ which leave the abdomen by the internal abdominal ring, external to the epigastric artery, as well as those less common forms which protrude between that vessel and the border of the rectus muscle. To indicate their relation to the artery they have been called external and internal herniæ;* but these terms are equivocal, though still often used. The herniæ which come out at the internal inguinal ring and pass down the canal are called oblique, partly on account of their direction in respect to the vertical axis of the body, and partly to distinguish them from the direct herniæ, whose axis is in the antero-posterior plane.

Para-Inguinal Herniæ.—M. Tuffier has described an opening above and external to the position of the internal ring which he found in a dissection subject in 1884. A rounded and well defined orifice pierced the aponeurosis of the external oblique. Behind it the fibres of the internal oblique were absent, and the subperitoneal fat presented. Viewed from within, the opening was above the external iliac artery and just to the outer side of the internal inguinal ring, with which it had no connection. M. Tuffier subsequently saw a patient of M. Richet's with an oblique scrotal on the right side, and a second small hernia escaping at a point a little above, and external to, the site of the inner ring through an opening in the aponeurosis of the external oblique. M. Tuffier thought that this hernia had protruded by an aperture like that whose anatomy he had previously ascertained. Herniæ in this situation are extremely rare, and not more than three have been seen at the Truss Society in the last twenty-five years. They are classed among the para-inguinal. It is very desirable in such cases that every assurance should be given that they are not protrusions at the site of an old abscess.

Oblique herniæ include the majority of ordinary inguinal, as well as all those with a congenital pre-formed sac. In the male 93 per cent. of inguinal herniæ are oblique. With the exception of interstitial herniæ, much has already been said of those with a congenital sac. Much has also been said of the formation and relations of the ordinary sac, but there still remains for consideration the coverings of the sac and the position of the spermatic cord and testis with respect to it.

* Terms used by F. C. Hesselbach.

The Coverings of the Sac have received a large amount of attention from surgical writers, but they possess little practical importance, and may be briefly dismissed. An oblique hernia carries before it the peritoneum and subperitoneal fat. As it enters the canal it receives a covering from the infundibuliform process of the fascia transversalis, which invests the cord under the name of the infundibuliform or internal spermatic fascia. In passing through the canal the sac is further protected by the cremaster, which, together with the tissue connecting its muscular bundles, forms the cremasteric fascia. On leaving the inguinal canal it is covered by the intercolumnar or external spermatic fascia, and is finally enclosed by the subcutaneous tissue with the dartos and the skin. It has been noticed on a former page that the serous sac as it leaves the canal enters the sheath of the spermatic cord, which often becomes so closely united with it that the distinction between the two membranes is lost.

Relation of the Cord to the Sac.—An oblique hernia protrudes at the inner ring in front of the spermatic cord, and keeps the same relation, as a rule, even when it descends to the bottom of the scrotum. If the hernia has not left the canal, the constituents of the cord are usually together in one bundle; but, when it enters the scrotum, the parts of the cord may be widely separated from one another, or the whole cord may deviate from its ordinary posterior position.

As an oblique hernia advances, it appears sometimes to press between the elements of the cord and separate them, and though the vas deferens has a position generally internal to the rest, it may be far apart from them. Thus the vas may occupy a place at the posterior and inner part of the sac, whilst the vessels are on the posterior or outer wall. The same thing may happen simply by the enlargement of the sac after it has reached the scrotum, or, as Mr. Lockwood has pointed out in hernia of the tunica vaginalis, the abnormal arrangement of the cord may be traced to the original disposition of the parts.

The position of the testis is usually below the fundus of the sac, and, though it is not infrequently on the side or front of the lower part of the hernia, it is seldom met with in other places. When it has a median position, the cord may approach it either from the outer or the inner side of the sac. M. Goyrand found the testis and adjacent portion of the cord on the front of a scrotal sac near the lower part. The constituents of the cord as they ascended diverged. The vas deferens turned round the inner border and the vessels around the outer border of the sac, to meet together again at the external ring behind the hernia. When the testis is at the inner side of the rupture, the sac appears to cross in front of the cord near the external inguinal ring. If the testis is high up on the front of the sac, the cord may reach it by curving round the outer border. The occasional anterior position of the cord renders it

liable to division in operations on oblique scrotal hernia, an accident which has to be guarded against.

Symptoms of Inguinal Hernia.—The symptoms of oblique inguinal hernia will now be given; and inasmuch as they include those common to all herniæ, it will not be necessary hereafter, in describing the different kinds, to do more than point out the symptoms peculiar to each of them.

Local Symptoms.—There are cases in which a rupture descends and remains for many years unheeded, and it is difficult to resist the testimony of those persons who declare that the swelling has never given them uneasiness. In some a very considerable tumour exists, and seems in no way to interfere with active habits of life. Such was that antique Roman, whose case has been quoted by Morgagni, and may be given here nearly in the words of his English translator.

Marcus Servilius had been consul and master of the horse, and had fought in twenty-three pitched battles. Livy relates of him that whilst he was haranguing the people and showing the scars of wounds which he had received in the fore part of his body in the cause of his country, the parts which should have been concealed were accidentally uncovered, and a tumour of the groin was seen, which raised a laugh in those that stood near him. Whereupon he went on to say, "And this tumour also, which is the subject of your laughter, I got by sitting night and day on horseback; nor am I more ashamed or sorry for this tumour than I am for these scars, since it was never any impediment to me in the administration of the Commonwealth either at home or abroad."

Yet few there be who are gifted with the same insensibility or the same fortitude as Marcus Servilius. Herniæ in most instances give rise to pain or discomfort, and even in those women who conceal their infirmity, it must not be supposed that they do not suffer from it. The inquiries of the author, directed to this subject, lead to the conclusion that, as a primary symptom, pain is only absent in something under 4 per cent. of all cases. The principal signs of hernia are the pain and the tumour; besides these there are some more general symptoms depending on disturbance of the alimentary canal.

The Pain.—The pain is referred to three chief situations, viz., to the region of the hernia, to the abdomen, and to the back. It may affect all three places at once, or may be confined to two or to one of them. Pain at the site of the rupture will be considered first, as it is by far the most frequent and is the initial symptom.* If the exact situation of the internal abdominal ring is defined, it is found that the patient complains of pain at this spot, which may be either an acute pain or a dull pain.

* Among cases of early hernia examined by the author, pain at the site was three times more frequent than pain in the back, and twice as frequent as pain in the belly.

The acute pain, which is a little more common at the beginning of a rupture than the other, is described as a pricking, cutting, piercing, or burning, scalding pain. This is a very striking symptom, and did not fail to arrest the attention of Ambrose Paré, and some others after him. It is sometimes the only token by which we can recognise a rupture at its birth when no swelling and even no undue impulse can be detected. This sign is unequivocal, hence it is obviously of the first importance that it should be rightly interpreted before the rupture has attained palpable dimensions. In cases almost equally numerous the patient suffers an aching, dragging pain at the inner ring; it is not so characteristic as the former.*

The pain in the abdomen has its most common seat and greatest intensity about the umbilicus. Often it radiates from the groin to the navel. It is usually described as a griping, gnawing, dragging pain at the navel, but it may be sharp or cutting. A patient every now and then complains that the pain spreads upwards, "flies up to the heart" or even to the neck. In such cases the patient probably confounds with his pain the feeling of sickness which sometimes comes with it, and which will give rise to a "sinking at the heart" and unpleasant sensations in the throat and stomach. With incipient rupture pain in the back is not a common symptom; it is generally aching in character, and may be felt across the loins, or just external to the erector muscles of the spine. In old and large herniæ, however, it is seldom absent.

There are certain unusual **manifestations of pain** which may give warning of a rupture. These pains are referred to the course of distribution of the ilio-inguinal or genito-crural nerves.

A severe sharp pain, which may precede the hernia, is felt occasionally in the testis and side of the scrotum; or in the labium majus in the female. It may also be met with when the external abdominal ring is undergoing dilatation. In rare instances pain is felt along the side of the penis. In cases still more rare the pain is over the outer side of the hip, apparently following the iliac branch of the ilio-inguinal nerve.

A woman, æt. 23, suffered for two months from a sharp, cutting pain over the hip. She used to place her hand just behind the great trochanter. The pain was most intense when she walked or used exertion. A rupture at length appeared at the inner ring, when the pain became less, and ceased after the application of a truss.†

Four cases have fallen under the author's observation in which pain

* Pain was felt at the site only in 56 cases; at site and abdomen, 21; at site and back, 16; in abdomen only, 14; at the three situations, 6; in back only, 4; in back and belly, 1.

† A man, æt. 34, with a recent left inguinal hernia, had pain in the groin, and so severe a pain behind the trochanter that he walked lame. All this was completely relieved by a truss.

was complained of in Scarpa's triangle, and seemed to take the course of the crural branch of the genito-crural nerve. This pain may precede or accompany a rupture.

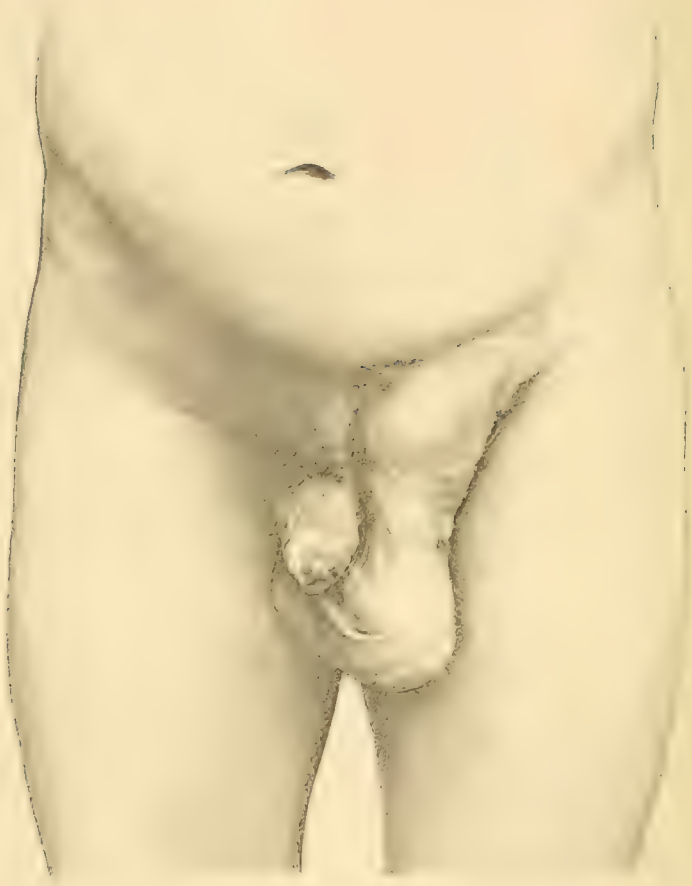
The Protrusion. The first sign of the protrusion is a bulging at the inner abdominal ring. This is quite limited in area, and, if the patient is lying down in a good light, is easily seen when he coughs. To quote once more Malgaigne's remark, it is more easily seen than felt. Nothing is seen or felt at first unless the patient coughs or strains. It is recommended that the patient should lie down, because, though the impact of the rupture against the hand is less forcible in that position, it is more sudden, and therefore better appreciated.

Impulse on Cough.—Whether the hernia is only at its first beginning or is fully formed, the momentary increase in it during cough imparts a movement to the hand, the so-called "impulse on cough" which is perhaps the most valuable of all the signs of rupture. It may be perceived by the hand laid upon the inguinal region or by the finger passed up the inguinal canal. But unless the external ring is large, or has been dilated by the hernia, the finger cannot be introduced. To explore the canal the index finger should be placed on the front and lower part of the testis, and thence be pushed upwards through the external ring, invaginating the scrotum. By beginning low down the finger obtains the longest possible excursion.

If the patient coughs when the finger is within the canal, a rupture strikes against the tip of it and makes an impulse there. This must be carefully distinguished from a false impulse communicated to the finger by the drawing together of the walls of the inguinal canal when the abdominal muscles contract. In this case the finger is pressed from side to side, but the impulse of a rupture is felt by the tip of the finger.

The first symptoms of a hernia, therefore, are pain and impulse on cough. If the impulse cannot be detected, the pain, above described, is sufficient to enable the practitioner to foretell a hernia, and the future will justify his prediction. After a time the transient bulging becomes permanent, and a small rounded swelling is seen at the internal inguinal ring when the patient is erect. It subsides in the supine posture to reappear on cough. Soon, however, the swelling remains, even when the patient is lying down. The condition then presented is seen in Plate IV., where on the left side an oblique, in this early stage, is seen in company with a direct hernia. The hernia, now fully constituted, gradually descends the inguinal canal, and after dilating the external ring, escapes into the upper part of the scrotum. So long as it remains within the external ring, it is termed bubonocele or incomplete hernia.

The Manner of Return of the Viscera.—When the viscera protrude so far as to form a tumour, they give useful evidence as to their nature by



the manner of their return to the abdomen. If the bowel alone is out, the last part to return goes in suddenly, and, if fluid is within it, a gurgling is heard at the moment of reduction. If omentum is present, it returns after the bowel, and goes in slowly and noiselessly even up to the last. This behaviour of the bowel and omentum is constant for all herniæ and for herniæ of every size.

Peculiarity of Hernia in Children.—Except in the earliest stage, a rupture is not difficult to detect in the adult, because a protrusion can almost always be brought to light by making the patient cough. Little children, however, cannot be made to cough or strain, and when they do strain the hernia will not always appear. It is a peculiarity of children's ruptures that one day they will form a considerable tumour, and after being put back, will remain reduced for days, perhaps weeks, even months. Camper remarked that "on this account a clever surgeon oftentimes denies the existence of a rupture, which shortly before has been clearly seen by another." [1] Owing to disregard of this circumstance, the ruptures of children are often overlooked at the present day, as they were in the time of Camper.

Scrotal Hernia.—When an oblique hernia has descended the inguinal canal and dilated sufficiently the external ring, it enters the upper part of the scrotum, and meeting with less resistance, begins to increase more rapidly in size. After passing the external ring it is a "complete" hernia, and is called, from its position, "oscheocele" or "scrotal" hernia. Its most characteristic form is pear-shaped, but it may deviate from this in one of two directions; it may tend to become globular or cylindrical. Occasionally the hernia below the external ring is cylindrical in its upper part and globular below. A hernia in the tunica vaginalis is not uncommonly spherical, and those in the funicular portion are usually cylindrical. A somewhat imperfect specimen of funicular hernia is seen in Plate V. The nature of a scrotal hernia is discerned by the pain, the tumour, the impulse on cough, and by the surgeon being able to feel through the sac wall the structure of the parts protruded.

Resonance on Percussion.—Some consider the use of percussion to be a valuable aid to diagnosis, and Piorry thought that it could indicate not only the presence of bowel, but also to what part of the alimentary tract the bowel belonged.[2] Resonance on percussion will be heard, if the bowel is near the surface and contains gas. But as the bowel in a hernial sac may be empty, or may have fluid contents, or may be overlaid by a thick layer of omentum, a dull note on percussion will not always imply the absence of intestine. On account of its uncertainty, therefore, little assistance can be looked for from the percussion note.

Signs of Intestine in the Sac.—Besides the resonance, which is often wanting, there are three signs by which we ascertain the presence of

intestine in a rupture. Of these the most certain is the gurgling when the swelling is compressed, but this will not be heard if the bowel is empty. Secondly, the tube of the intestine can often be felt through the sac wall, and its attachment to the mesentery can be traced. Thirdly, if the hernia can be put back, the sudden manner in which the bowel returns to the abdomen is highly characteristic. Enterocele is almost always reducible, and in entero-epiplocele, though the omentum may be irreducible, the bowel is generally reducible. Among cases of irreducible hernia the intestine is irreducible in only 9.4 per cent. (Chapter XXV., Table XXVI.). This last sign, therefore, is very rarely absent.*

Signs of Omentum in the Sac.—The omentum is characterised by its slow, gradual, and noiseless return to the abdomen. When it is handled through the integuments, it is uneven and soft, but numerous firm spots are felt in it on account of the fatty pellets with which it is studded. If it is gently drawn down, it can be examined more easily and unravelled. It is in front of the bowel, and is the last to return to the abdomen. It has often been described by surgical writers as "pasty," but paste retains the impression of the finger, while the omentum does not. There are two substances so nearly resembling the omentum as sometimes to give rise to difficulty in diagnosis. The appendices epiploicæ have been felt in a hernial sac and thought to be omentum (Petit), and when a large hernia has been returned, the shrunken sac has been mistaken for omentum. Under such circumstances, if the sac is invaginated and the neck explored by the finger, this error can be at once corrected.

Large Herniæ.—A scrotal hernia may continue to increase till it holds all the movable viscera of the abdomen. Very large herniæ are not so common now as in old times, when the resources of surgery were more limited.

Joachim Camerarius saw a hernia weighing 40 lbs.,[3] and Morgagni quotes from Brebisius a case in which the tumour hung down to the calves of the legs.[4] Thomas Bartholin relates that he saw a hernial person at Venice whose intestines had so extended the scrotum that, like a great amphora, they hung down between the thighs. A trace only of the penis was left in the middle of the huge tumour by which the urine dribbled.[5] In these large tumours the penis is completely buried, and all that is seen is a small opening on the surface at the upper part of the rupture, like a "second umbilicus," as Shacher said. The urine flows over the skin and causes painful excoriation. But ruptures which reach the knee are seldom met with now, and even one so large as that depicted in Plate VI. is quite uncommon. The original size of this hernia was somewhat greater, but as the photograph was taken after

* In strangulated hernia, though the intestine can seldom be felt or heard, the symptoms of obstruction supply the necessary information.

Plate V.

Large Scrotal Hernia in a man æt 74

Danielsson & Co. sculp.

a truss had been worn for some hours, the swelling could not be brought down to its original dimensions.

Oblique Hernia Simulating Direct.—It is in the large herniæ especially, that the inner ring is so dilated, that it reaches to the border of the rectus muscle, and is directly behind the external ring. No trace can be felt of the posterior wall of the canal, and the protrusion is not to be distinguished from a direct hernia, except by dissection. Dr. Goulay dissected a female, seventy-two years of age, who, though bed-ridden for thirteen years, had a rupture of such a large size that the opening in the abdominal wall measured 9 inches in diameter.[6] The cases, however, with obliteration of the inguinal canal are rare, and in scrotal herniæ of considerable size the oblique direction of the swelling can usually be observed, owing to the preservation of part of the internal wall of the canal.

General Symptoms.—The pain and the tumour, which are the principal signs of hernia, have now been described; and there only remains for consideration the general symptoms which sometimes attend it. If a rupture is not retained, or is imperfectly retained, the patient is subject to flatulence, indigestion, colic, nausea, vomiting, and constipation. These symptoms are fitful, occurring with more or less severity according to the state of protrusion of the viscera, and ceasing directly the hernia is returned. They may come singly or in combination, and may accompany the local pain above described. Those who seek to know what manner of life the patients lead who neglect their ruptures, cannot do better than study obturator hernia. This is a rupture so seldom detected, either by the patient or the surgeon, that no means are used to prevent its descent; consequently, the history of such cases gives faithful and emphatic testimony of the sufferings which accompany a hernia unrestrained. The symptoms are not continuous, but come in paroxysms and pass off, leaving the patient for a time free from discomfort; but they recur again and again, till means are used to retain the hernia, or till strangulation makes an operation inevitable.

Oblique Hernia in Women.—Oblique inguinal hernia in women does not differ essentially from that in men. When it passes the external ring, it forms a tumour in the labium majus which sometimes reaches to the margin of the anus, and sometimes becomes pendulous. It has been already observed that labial hernia is relatively less common in women than scrotal in men, which is probably due to the difference in the occupations of the two sexes.

Double Hernia.—It was observed in Chapter II. that a double hernia descends on both sides at the same time in not more than 4.6 per cent. among males, and in something less among females. The two protrusions, therefore, constituting a double rupture, are formed at different

times in the great majority of cases. Malgaigne thought that the second usually follows the first rupture after a short interval; and that, if a rupture has long remained single, the opposite side is not likely to give way. It is difficult to verify this statement, for the second rupture is almost invariably of slow formation, and the date of its production uncertain. So far as my own observations serve, I find that the second hernia occurs at any period after the formation of the first, and not, in the majority of cases, immediately after the first. The Statistical Tables, indeed, seem to point to this, that, if life lasted long enough, all single herniæ would become double. There is this peculiarity about double herniæ, that the second is not so large or so troublesome as the first. If we consider a number of double herniæ of which one or both are scrotal, only 3.5 per cent. are scrotal on both sides.* Among the remaining 96.5 per cent. one side is scrotal, and that is almost always (viz., in 88.7 per cent.) the side first ruptured. In the exceptions to this rule, that the first hernia is the worst hernia, it is probable that the first hernia has been so far ameliorated by treatment that its natural propensity is concealed.

Hernia in the Tunica Vaginalis has the testis enclosed within the sac; this is its chief characteristic. As in hydrocele, the testis is found towards the back part of the swelling, a little below the middle. Sometimes the organ, as before remarked, is at the bottom of the sac. Occasionally a hernia occupies the tunica vaginalis of a testis which has not completely descended. Under these circumstances the testis is almost always under-sized and ill-developed. Hernia in the funicular portion of the tunica vaginalis cannot be diagnosed with certainty during life. It is generally narrow and cylindrical, with the testis applied closely to the lower end.

Hyperæsthesia of the Testis.—Among the numerous cases in which hernia accompanies an ill-developed testis or a testis arrested in its descent, a small proportion of the testes are more sensitive than usual, and the hernia often participates in the hyperæsthesia. This tenderness varies in degree in different persons. In some it amounts to no more than a slight increase of the normal sensibility of the organ, whilst in rare cases it is so excessive that not only the lightest touch, but even a puff of air, seems to give the patient agony. Among 295 cases in which the testis was misplaced or ill-developed, 10.1 per cent. were hyperæsthetic.† I have not observed that this peculiar tenderness

* Among 731 double herniæ examined by the author, the side first ruptured was scrotal, and among 25 double scrotal the largest hernia was on the side first ruptured. Among 91 double herniæ the side last ruptured was scrotal, and among 5 double scrotal the largest hernia was on the side last ruptured.

† Examined at the Truss Society in 1889 and 1890.

manifests itself as a rule before puberty. Among the cases affected with hyperæsthesia above-mentioned, only one was so young as twelve years.

REFERENCES TO CHAPTER XVI.

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2. **Piorry.**—Gaz. des Hôp., 1844, p. 506.
3. **C. H. Papen.**—Haller's Disp. Chir. Sel., 1765, iii. 314, Note C.
4. **Morgagni.**—De sed. et causis morb., trans. 1769, ii. 550.
5. **T. Bartholin.**—Hist. Anat. Rar., 1654, Amst., Cent. ii., His. 94.
6. **Goulay.**—New York Med. Jour., July 30, 1887, p. 138.

CHAPTER XVII.

ON DIRECT INGUINAL HERNIA.

Direct Hernia, a Hernia in the Linea Semilunaris.—Direct hernia is a hernia of the linea semilunaris, and belongs rather to the class of ventral than to that of inguinal herniæ. Wherefore Monro called it ventro-inguinal, and Scarpa speaks of it as a combination of inguinal and ventral. But it has always been found most convenient to describe the oblique and direct together, and this arrangement will, therefore, still be adhered to.

Discovered by Heister.—Direct hernia was detected first by Heister in the body of a rope-dancer, as Camper[1] tells us, who himself dissected a case in 1759. Alexander Monro, when he was studying at Berlin in 1771, also met with a case.[2] Sir Astley Cooper devoted a short chapter in his work to direct hernia, and Franz Caspar Hesselbach published in 1814 the most important contribution which has appeared on the subject.*[3]

Age of Occurrence.—Direct hernia is a hernia of adult life, and apparently attains its greatest frequency between forty and fifty years of age. It is probable, however, that it develops after fifty even more abundantly, though this does not appear in Table XVII., as no correction has been made in it for decrease by death in the population. Among a given number of inguinal herniæ the direct amount to 6.9 per cent.,†

* He published his first essay in 1806. Meckel quotes a case seen by Monteggia, and Russel described a direct as a "new species" of hernia in Trans. Roy. Soc., Edin., 1805.

† Among 269 cases of inguinal examined by the author, 18 were direct=6.9 per cent.

and this agrees very nearly with the estimate given by Brünninghausen and adopted by Hesselbach.

This Hernia originates on the Right Side more commonly than is the case with inguinal herniæ in general which arise at the same period of life. (Direct right : left = 1.46 : 1, Table XVII.) The reason of its greater frequency on the right side is not apparent, but the probable effect of it is to increase the ratio of right to left among inguinal herniæ in old age.

Position of the Aperture of Exit.—A direct hernia traverses the abdominal wall between the outer border of the rectus muscle and the epigastric artery. It enters the lower and inner part of the inguinal canal, expands the aponeurosis of the external oblique and the external ring, and sometimes descends into the scrotum. Much attention has been paid by the anatomists to its position in respect to the obliterated hypogastric artery. Generally it escapes between that vessel and the epigastric, but occasionally the hypogastric is so far out that the protrusion passes between it and the edge of the rectus muscle. When Velpeau[4] met with the last-named condition, he described it as a new species of inguinal hernia under the name of "hernie inguinale oblique interne." In the case which fell immediately under his notice, the hernia had come through the linea semilunaris a short distance above the pubes, and had dilated the inner part of the inguinal canal without making much impression on the external ring. Velpeau describes the hernia as directing its way along the inguinal canal obliquely outwards, which is signified by the name that he conferred upon it. Every direct hernia occupies, during part of its progress, the inguinal canal, and forms a considerable swelling within it before passing the external abdominal ring. As the resistance is greater towards the rectus than in the opposite direction, the rupture may appear at a certain stage to have its axis pointing downwards and outwards instead of downwards and forwards. If a direct hernia, after entering the canal near the rectus, passes along it towards the internal inguinal ring, as Velpeau maintained, the condition is so extremely rare that no further mention of it is necessary.

Relation to the Hypogastric Artery.—The course of the obliterated hypogastric artery is very variable, and consequently the width of the two inner hypogastric fossæ varies in correspondence with its position. If the vessel is external to the margin of the rectus, a hernia may traverse the posterior wall of the inguinal canal on the one or the other side of it. Sir Astley Cooper records a case in which, on each side, two herniæ were between the epigastric and hypogastric arteries, and one between the hypogastric and the border of the rectus.[5] The hypogastric artery and the fossæ, which its projection occasionally produces, have merely an anatomical interest, and do not appear to possess any material influ-

ence upon the hernia under consideration. It is probably on this account that Hesselbach gives so little prominence to the relations of the artery to the neck of the sac. A hernia occasionally comes out through an opening in the aponeurosis of the external oblique a little way above the external inguinal ring. It is a hernia through the lower, but not the lowest, part of the linea semilunaris. Like one already described, which protrudes in the vicinity of the internal ring, this likewise has been called para-inguinal. A hernia was observed by Cloquet to come out between a separation of the fibres of the tendon of origin of the right rectus muscle.[6] It occurred in a male, æt. 47.

Anatomy of Direct Hernia.—Direct hernia either pushes before it the structures forming the posterior wall of the inguinal canal, or passes through an opening or split in one or more of them. Hesselbach appears to have found the sac traversing a gap in the fascia transversalis and conjoined tendon of the internal oblique and transversalis muscles. Sir Astley Cooper generally saw the fascia transversalis protruded in front of the sac through the fibres of the tendon of the transversalis muscle and under the edge of the internal oblique. Aston Key found the fascia transversalis and conjoined tendon intimately blended together and covering the sac. Sometimes there is a fraying in the transversalis fascia or in the conjoined tendon, but more commonly these structures are merely bulged before the sac.

Modes of Origin.—In view of these anatomical states, Sir Astley Cooper suggested three modes of origin for this hernia, viz., by a weakening, or a tearing, or an absence of the conjoined tendon. In correspondence apparently with these modes of origin, the onset of the hernia is either gradual or sudden.

Among 68 single direct herniæ examined by the author, 23 came suddenly, and 45 gradually; and among 77 double direct, 4 came suddenly on both sides, 49 gradually, while in 24 it came suddenly on one side and gradually on the other. The gradual formation, therefore, is the most usual, as is also the case with oblique hernia. Some have supposed that, whether the descent takes place gradually or suddenly, the viscera enter a pre-formed sac. In support of this, Englisch has recorded the occasional presence of peritoneal pouches in the space between the hypogastric and epigastric arteries.*[7] They occur most commonly about the umbilical region, according to Linhart. Englisch states that the fascia transversalis was bulged before these pouches when they attained any magnitude and was not riven. In certain cases a direct hernia had formed on one side, and a peritoneal diverticulum was present on the other. When it is remembered that in double hernia the two protrusions are seldom equal, but that one precedes and has larger dimensions than

* Englisch examined 300 bodies, and found peritoneal pouches in 6 of them.

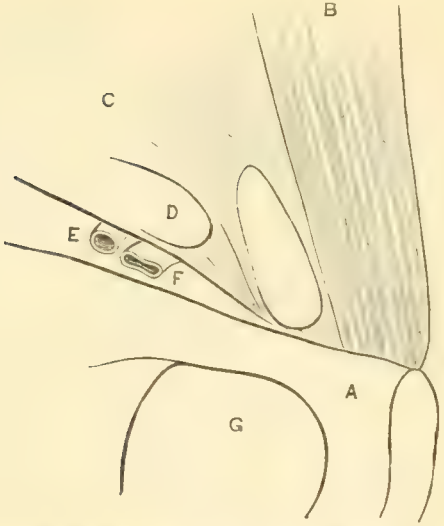

FIG. 8. The inner aspect of the inguinal region from which the peritoneum has been removed. The aperture of a direct hernia is seen occupying the greater part of the space between the rectus and internal ring. A, the pubes. B, rectus. C, inner wall of canal. D, inner ring. E and F, femoral vessels. G, thyroid foramen. H, Fig. 11, the line of the epigastric artery. (*After F. C. Hesselbach.*)

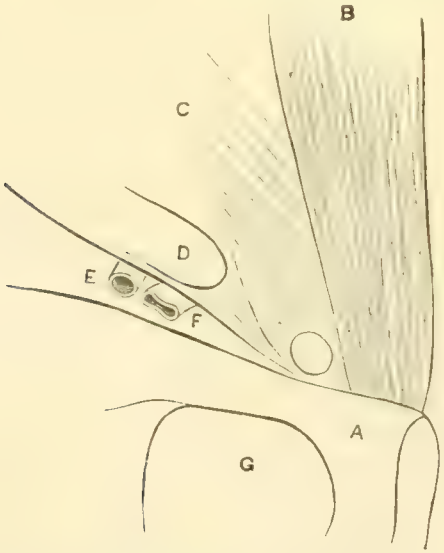

FIG. 9.—The parts are similar to those in Fig. 8, but the aperture of the direct hernia is a small round opening in the angle between the rectus and pubes. (*After F. C. Hesselbach.*)

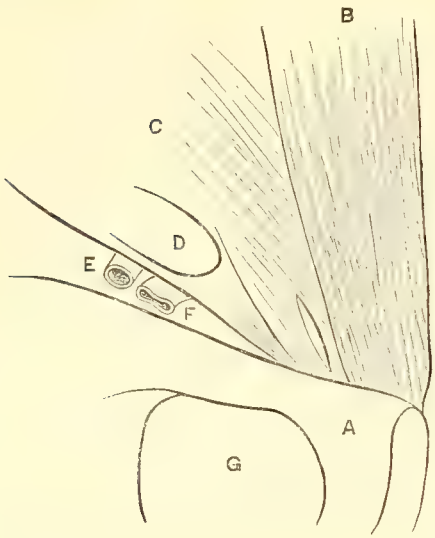

FIG. 10.—The same view as in Fig. 8, but the aperture of the hernia is a narrow split in the internal wall of the canal.

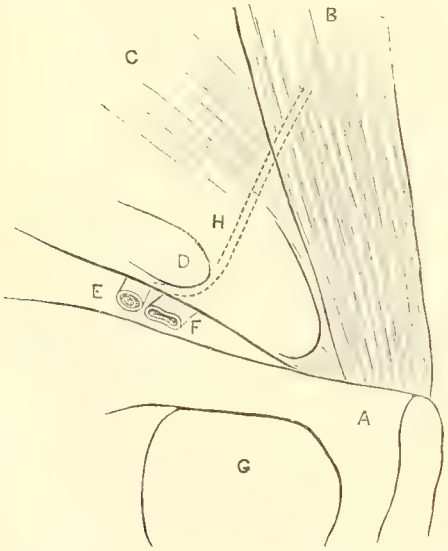

FIG. 11.—The same parts as in the previous Figs. Almost all the internal wall of the canal has disappeared between the rectus and the epigastric artery.

the other, there is strong probability that Englisch is correct in his conjecture, and that in some instances the viscera occupy these pre-formed sacs.

Aperture of Exit easily Explored in the Living.—The opening in the posterior wall of the inguinal canal through which a direct hernia comes, is much more accessible to examination in the living than the internal abdominal ring, so that it is quite possible, in the majority of cases, to explore the conjoined tendon with the finger and ascertain the shape and size of the opening as well as the extent to which the posterior wall has suffered. When a hernia is oblique, the posterior wall of the canal is felt as a plane surface by the finger passed into the external ring, and its attachment along the pubes can be traced. The finger is prevented from entering the abdomen till it reaches the internal ring, but in direct hernia, when fully developed, the finger at once passes over the bare pubes into the belly, and can feel the back of that bone and of the rectus muscle. No trace of the posterior wall of the canal is felt nor the margin of an opening in it. All that remains is a narrow layer of membrane, which just fills the angle between the pubes and the rectus; it seems as if the ligament of Colles had alone withstood the distending force of the hernia. In these cases, in which the protrusion has done its worst, all the posterior wall of the canal between the rectus and epigastric artery has gone, and the large opening has a triangular figure, coinciding with the triangle of Hesselbach (Fig. 8).

If the hernia is examined at an early stage, the posterior wall of the canal either presents a small round opening (Fig. 9) or a narrow slit (Fig. 10). When there is a rift in the posterior wall, it generally has an oblique direction, with one end near the pubes, and the other pointing upwards and outwards (Fig. 10). An interval of 2 to 3 lines, as a rule, separates it from the edge of the rectus. In two cases the author found a slit in the posterior wall, whose inner boundary was formed by the edge of the rectus. When the opening is round, its lower margin is usually 2 or more lines above the pubes, and it may be adjacent to the rectus, or more commonly 2 or 3 lines distant from that muscle. It is seldom so far from the rectus as two-thirds of an inch. The border of these round openings is well defined; sometimes it is firm, but in other cases it is very thin and yielding. Besides the rounded or slit-shaped aperture in the internal wall of the canal and the large triangular gap, there is a fourth condition in which all the tissue between the edge of the rectus and the epigastric artery has been lost. In such cases a portion of the posterior wall of the canal is felt towards the rectus, and has a rounded edge with the concavity looking outwards. But towards the inner ring no vestige of the posterior wall can be found (Fig. 11).

Stages in the Formation of Direct Hernia.—It appears probable that

the four states here described * (Figs. 8, 9, 10, 11) are not independent, but are gradations in the development of the hernia. When a double hernia is present, the two protrusions rarely come out at the same time, but one generally precedes the other; therefore the first is further advanced than the second. This is true of all herniæ. Among the oblique it is very rarely that both are scrotal, but in a great majority the older hernia is scrotal, and the recent one is in the canal. In double direct also the herniæ are in different stages, and that which last protruded has always a larger part of the posterior wall of the canal preserved than the older hernia. Assuming, then, that the above supposition is correct, it is evident that as a direct hernia develops, it enlarges at the expense of the internal wall of the canal, and that it encroaches on each side, but principally in the direction of the epigastric artery, until the whole of the posterior wall of the canal between the artery and the rectus muscle has disappeared. This final condition is frequently arrived at before the rupture has passed beyond the external ring, and it is one of the chief characteristics of direct hernia that the opening may be so large, and the tumour relatively so small. The ordinary form is that of bubonocele, and it is comparatively seldom that the protrusion reaches the scrotum.†

The external ring is partly shielded by the rectus muscle, and the hernia has to dilate or split up the outer part of the ring before passing beyond it. The sac of this hernia is globular, and therefore a considerable enlargement of the external ring must be effected before the protrusion can traverse it.

Relation of the Sac to the Spermatic Cord.—The spermatic cord comes into contact with the sac near the inner part of the canal, and is, as a rule, on the outer side of it in the scrotum. The cord has been found, however, crossing the front of the scrotal sac at the upper part and descending along the inner side.[8] Sometimes the constituents of the cord are separated. The elder Monro found the vas deferens running down the front of the sac and the spermatic vessels behind it. The same precaution, therefore, must be used in operating upon this hernia as with the oblique, to avoid division of the cord.

Coverings of the Sac.—The coverings of the sac vary considerably according to the mode of origin of the hernia. The peritoneal sac carries before it the subperitoneal fat, the transversalis fascia and conjoined

* In 100 cases of direct hernia the author noted and drew the condition of the aperture in the posterior wall of the canal. In 8 it occurred as a narrow split, in 13 as a small round hole, in 29 as a segment of a circle, and in 50 no trace of the posterior wall could be discovered.

† Among 63 single direct herniæ, 14 were scrotal, and 49 in the canal; and among 61 double direct, 36 were bubonoceles, 5 were scrotal, and in 20 the older hernia was scrotal, and the recent one bubonocele.

tendon: on leaving the canal it is covered by the intercolumnar fascia and by the subcutaneous tissue with the dartos. The sac sometimes receives no investment from the cremaster; in other cases it is partially covered by that muscle at the outer part. M. A. Broca maintains that direct hernia, and every hernia which passes the external inguinal ring, is covered by the cremaster.[9] Direct hernia sometimes passes through a split in the transversalis fascia * or conjoined tendon, or it may come out through an interval between the fibres of the internal oblique muscle.† Thus some of the coverings of the hernia may be wanting.

Symptoms of Direct Hernia.—When direct hernia has descended into the scrotum, it cannot be diagnosed with absolute certainty from an oblique hernia. For it has been seen that the position of the spermatic cord is so variable in this and in oblique hernia that it gives no reliable information. If the finger follows the hernia on reduction, it passes over the pubes directly into the abdomen; but in some cases of oblique hernia the inner ring is displaced so far inwards as to be opposite the external ring, and therefore the position of the opening in the posterior wall of the canal is not a certain sign when the rupture is scrotal. Some surgeons claim to be gifted with a sense of touch so delicate that they are able to feel the beating of the epigastric artery between the finger within the neck of the sac and the thumb on the surface of the abdomen. A pulsation is often felt under such circumstances proceeding from the digital arteries of the surgeon, but those who pretend to more than this, surrender themselves to a flattering delusion.‡ The diagnosis of direct scrotal must therefore be always attended with some uncertainty, but it should be remembered that with oblique scrotal a portion of the posterior wall of the inguinal canal is generally left, and, as a rule, in sufficient quantity to preserve the oblique direction of the neck.

But a direct hernia, whether above or below the pubes, has no such direction, but always appears to descend in a perpendicular plane. When it is above the crest of the pubes, as is usually the case, it forms a hemispherical swelling which tends inwards to the middle line; and, if two herniæ are present, their inner borders are in contact, as is seen in Plate VII. The form and position of the tumour are the most characteristic signs of direct hernia; and if the posterior wall of the inguinal canal has not been destroyed, the opening in it can be easily felt. In

* M. A. Broca in twelve dissections of direct hernia has in every instance found the sac invested by the fascia transversalis.

† The author possesses a dissection of a hernia of this kind.

‡ The epigastric artery was once seen by Hesselbach coming from the external iliac, and springing from a trunk common to it and the obturator, just as the latter vessel turned over the brim of the pelvis. The epigastric ascended behind the rectus muscle, near its outer border, internal to the sac of a direct hernia.

TABLE XVII.

PART I.—*Direct Herniæ in Males, arranged according to the Age of the Patient and the Side Ruptured at the first appearance of the Hernia.*

	16–20	21–25	26–30	31–35	36–40	41–45	46–50	51–55	56–60	61–65	66–70	71–75	76–80	81–85	TOTAL.
Right . .	2	5	9	8	12	17	21	12	15	5	5	1	...	...	112
Left . .	2	2	6	15	8	14	11	9	4	2	3	...	...	1	77
Double . .	1	1	1	...	2	3	...	...	1	2	..	...	...	...	11
Total .	5	8	16	23	22	34	32	21	20	9	8	1	...	1	200

PART II.—*Contains the same Cases as Part* I., *arranged according to the Age of the Patient and the Side Ruptured at the time of his visit to the Truss Society.*

	16–20	21–25	26–30	31–35	36–40	41–45	46–50	51–55	56–60	61–65	66–70	71–75	76–80	81–85	TOTAL.
Right . .	...	...	1	2	4	2	4	5	8	12	7	3	3	...	51
Left . .	..	...	...	2	1	1	5	8	4	4	3	4	2	...	34
Double . .	...	...	...	2	5	13	14	15	17	27	10	8	3	1	115
Total .	...	...	1	6	10	16	23	28	29	43	20	15	8	1	200

Note.—The second part of Table XVII. does not represent the actual state of the cases, because several patients had a double hernia of which one was oblique, and some few had direct inguinal in company with femoral hernia.

rare cases an oblique hernia will make very little projection till it nears the external ring and then rises as a rounded swelling, like a direct rupture. An instance of this is seen in Plate IV. on the right side. No difficulty is experienced in such cases, for the posterior wall of the canal is felt to be perfect. It is only in certain cases of scrotal hernia, therefore, that there can be any danger of mistaking oblique for direct hernia. In women the diagnosis is uncertain, because in them it is not possible to explore the inguinal canal, and the symptoms are limited to the form and position of the swelling.

Double Direct Hernia.—It has been asserted that direct hernia is always, or almost always, double; but though this is not strictly accurate, the tendency to the formation of double hernia appears much stronger in this than in inguinal herniæ in general. On reference to Table XVII. it will be found that 55 per cent. of single direct ruptures become double; whereas 36.6 per cent. of inguinal herniæ in Table I. become double. It may be, however, that this increased tendency to double hernia is apparent rather than real: for the percentage derived from Table I. is obtained from cases arising during the whole of life, whilst that from Table XVII. is from cases arising during a part of life. The question can only be determined with certainty if the cases to be compared are all taken from the same periods of life.

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2. **Monro.**—On the Gullet, 1811, p. 462.
3. **F. C. Hesselbach.**—Ueber d. Ursprung u. d. Fortsch. d. Leisten- u. Schenkelbruche, 1814.
4. **Velpeau.**—Mem. sur une nouv. espèce de Her. Ing., Ann. de la Chir. Franç. et Étrang., 1841, i. 257.
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6. Cat. Mus. Dupuytren, 1879, vol. iv., No. 242.
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CHAPTER XVIII.

ON INTERSTITIAL HERNIA.

Nomenclature.—The viscera sometimes find their way between the layers of the abdominal wall and constitute a hernia which appears under several forms and has been encumbered with a multitude of names.

The designation used by Goyrand,[1] interstitial, indicates very well its characteristic feature, and comprehends its different varieties. One of the best known writers on the subject preferred the term intra-parietal,[2] but this might be taken to mean that the hernia is on the inside of the parietes; whilst among the other names I have not met with one which conveys so clearly as interstitial, that the hernia "stands or is between or among" the layers of the abdominal wall. Interstitial hernia is not only complicated in itself, but its recognition has been rendered still more difficult by the carelessness of those who have confounded it with herniæ of other kinds.

M. Goyrand includes among his cases two small direct herniæ which had not escaped from the inguinal canal.* Such herniæ are indeed between the layers of the abdominal wall, but they come under the title of bubonocele, or incomplete inguinal; whilst interstitial hernia transgresses the ordinary limits of inguinal hernia, this being its distinctive peculiarity.

The Three Kinds of Interstitial Hernia.—The viscera may be placed, (1) between the parietal peritoneum and the fascia lining the abdominal muscles, or (2) between the internal and external oblique muscles, or (3) on the surface of the last muscle between the aponeurosis and the skin. With any one of these a part of the hernial sac may descend the inguinal canal, and may even reach the scrotum.

A protrusion in the inguinal canal may be said to be invariably present, though it is only in a few cases that this enters the scrotum or labium; but a bulging of the abdominal wall may or may not accompany the inguinal portion of the hernia; so that the three kinds above defined may be resolved into those which have a ventral swelling and those which have none. The second and third of the above divisions always have a bulging of the parietes besides that in the canal or scrotum. So, likewise, with some of the cases in the first division, but in the rest there is no external sign which distinguishes them from ordinary hernia, and hence arises their danger.

* Sir William Lawrence has made much the same mistake.

Interstitial Hernia without a Ventral Swelling.

It will be convenient to consider first of all the cases in which no extraordinary swelling is present. Some of these are well exemplified by a case related by Hernu in 1802 of a man, æt. 40, who came under his care for a right inguinal rupture, which had been for seven days strangulated.[3] The malady had been long neglected, and only within the last few years had the patient worn a truss. The hernia reached the middle of the scrotum, was soft and in part reducible. Herniotomy was performed, the sac opened, and the omentum therein was ligatured and cut off. The stump did not return completely into the belly, but kept coming down, so that a pad was applied to keep it up. Death occurred four days afterwards.

Besides the inguinal sac, opened during the operation, which contained only a mass of omentum, there was behind the inguinal canal, between the pubes and bladder, another sac formed by a fold of peritoneum in which was enclosed a loop of gut partly gangrenous. The two united sacs resembled a "besace," a double bag, which, with its middle resting on the horizontal ramus of the pubes, descended on one side to the bottom of the scrotum and formed the external sac, and on the other descended between the pubes and bladder and contained gut. The entry of the inner sac was almost at the level of the inguinal ring. It was rounded, firm, as it were ligamentous, and the gut in order to enter it was obliged to turn and to form almost an acute angle with the rest of the intestine.

In such cases as these the two parts of the sac have a common opening through the parietal peritoneum into the abdominal cavity. The sac generally lies between the pubes and bladder, but sometimes rests against the obturator internus muscle. This condition is not necessarily limited to inguinal hernia, for more than one case has been recorded of a femoral hernia having a diverticulum between the pubes and the bladder. It is evident that a hernial sac in these positions gives no outward sign; and so long as the function of the bowel is undisturbed, there is nothing to excite suspicion of a twofold sac. But when the bowel has been strangulated in the abdominal sac, and an operation has been performed on the inguinal portion of the hernia, it has been generally noticed that the reduction of the protruded parts has been imperfect. Hernu observes that the omentum continually came down again after reduction, and that it was necessary to use a pad to keep it up. Life has been sacrificed in these cases by neglect of this sign, which indicates that the operation is incomplete, and that the exploration must be carried further.

The herniæ just described were called "inguinalis antevesicalis" by

Parise to distinguish them from the more common variety the "hernia inguinalis intrailiaca," in which the deep sac occupies the iliac fossa. Both these herniæ are included under the common name "hernia inguino-properitonealis" by Krönlein, whose valuable work on the subject has obtained universal recognition.[4]

Hernia Inguinalis Intrailiaca.—The principal features of hernia inguinalis intrailiaca are found in a case related by Krönlein in 1876, which served as the foundation for his first essay. A man, æt. 54, who had been ruptured from infancy, came under the professor's care for a strangulated right inguinal hernia, which reached half-way down the scrotum. Reduction was made by taxis, and the ring was felt to be free. No abdominal tumour was noticed, but the belly was distended and offered increased resistance to pressure in the right inguinal region. The parts remained reduced, but, as the symptoms continued, herniotomy was performed. The sac was opened, and some inodorous serous fluid let out. The finger passed easily along the canal, which was empty, and high up at the inner ring it met with a smooth, tense, elastic membrane, which was thought to be a loop of intestine, fixed in that position. The whole canal was therefore split up, and by introducing the finger through the inner ring and directing it outwards, a firm string or band was encountered, under which the above-mentioned loop of intestine passed. This string was divided, when a gush of stinking bloodstained fluid poured over the "whole field of operation." The cavity containing intestine was now accessible, and 20 centimetres of gangrenous bowel were cut away and the ends reunited.

After death the cavity, containing the resected bowel, was found to be a large diverticulum of the sac, lying in the iliac fossa between the parietal peritoneum and the fascia transversalis. The finger had not entered the general peritoneal cavity during the operation. The intra-iliac part of the hernia was furnished with a neck, whose entry was bounded by a firm ring, of which the upper edge had been felt and divided during the operation. The mouth of the diverticulum communicated with the neck of the inguinal sac at the outer side, and the neck of the inguinal sac communicated with the abdomen by an orifice, the "ostium abdominale" of Krönlein, which was separated from the internal inguinal ring for some distance.

The Site of Strangulation.—In this case the strangulation was not at the mouth of the twofold sac, the "ostium abdominale," but at the mouth of the diverticulum. Therefore it had been possible to reduce the viscera in the inguinal sac into the abdomen, whilst another portion of bowel was strangulated at the entry of the intrailiac sac. In general, however, the seat of strangulation is the common mouth, or ostium abdominale, in which case reduction of the external protrusion is

incomplete. And this, as has been remarked before, affords a most important indication for operation, or for further exploration when an operation has been begun.

The mouth of the diverticulum may be placed laterally to the main channel, as in Krönlein's case, or may itself be the ostium abdominale. The diverticulum has then two openings, one to the abdominal cavity, and one at the site of the internal inguinal ring leading into the external portion of the sac.

Position and Relation of Properitoneal Hernia.—The diverticulum lies in the subperitoneal tissue, with the fascia transversalis in front of it, and the parietal peritoneum behind and above it. The peritoneum of the diverticulum and the parietal peritoneum, where they are in contact, are found to be intimately adherent to one another to a greater or less extent. This circumstance is important, as showing that the diverticulum is not the result of a recent "reductio en masse," or forcible reduction of the hernia with its sac. Whatever forms and fashions the diverticulum is thus seen to be independent of the strangulation and of the proceedings to which it gives rise.

Mode of Formation.—But there is a very general opinion, dating back to the days of Hernia, that these diverticula, or properitoneal sacs, are formed by oft repeated attempts at reduction. If reduction is difficult on account of narrowness of the entrance of the sac, it is easy to conceive that the pressure may not only tend to separate the neck from the abdominal wall, but also to bulge the sac on the distal side of the neck within the abdomen. There is a hernial sac in the Museum of St. Bartholomew's Hospital which shows an early stage of this condition.[5] The neck is surrounded by a very tough ring of fibrous tissue. The sac dilates suddenly immediately below the neck, and there is a pouching of its posterior portion, which apparently extended upwards behind the neck. A month before death the hernia was reduced after long and forcible taxis under chloroform. No doubt on many previous occasions the patient himself had made strong pressure on the rupture when putting it back.

It has been suggested that if a truss is habitually worn resting upon the external ring, the portion of sac in the canal will be occupied by bowel and distended by the pressure communicated to it. This malposition of the truss is exceedingly common, but the hernia is exceedingly rare, which should not be the case if the diverticula were thus formed. Mr. Birkett demonstrated long ago that the supposition is untenable, but it was afterwards revived by Streubel.

That the formation of the twofold sac is not necessarily associated with a congenital anomaly of the peritoneum is shown by its occurrence in femoral and in direct hernia.[6] Yet in a majority of the cases the

hernia is in the processus vaginalis of an ill-developed or arrested testicle, and this fact suggests some causal connection between the congenital anomaly and the deformity of the sac.

In a former chapter I have pointed out that the mouth of the sac is very narrow, as a rule, in hernia in the processus vaginalis. If, then, the diverticula have a mechanical origin, as above explained, the narrowness of the orifice of the processus vaginalis would favour their formation, and we should expect to find the properitoneal herniæ in most instances occupying a congenitally pre-formed sac. According to this theory the pressure that forms the pouch comes from without, but Streubel suggested that the same effect may be produced by pressure from within.

When the testis is arrested it may remain in the belly or in the groin, and the processus vaginalis may end inside of the external ring. Streubel supposed that the hernia met with so much resistance at the external ring that it enlarged in an upward direction, that the mouth of the sac was thus separated from the inner ring, and that the part between the inner ring and the mouth suffered dilatation. It seems possible that resistance to the advance of a hernia may thus produce a twofold sac. As an illustration of this I will refer to a preparation in Guy's Hospital Museum, which was taken from the body of a female who had a right obturator hernia.[7] Unfortunately her history has not been preserved. The sac external to the obturator membrane is small, but within the pelvis there is a considerable pouch behind the obturator internus muscle. The bowel entered the upper part of the pelvic portion. The obstacles to the enlargement of obturator hernia outside the pelvis are well known, and it seems not unfair to conjecture that here the internal diverticulum owed its existence to this cause. Both the theories now stated would be more acceptable, if it were not that the requisite conditions are found so often and the herniæ so seldom.

A different mode of origin was propounded by Bär in consequence of the following observations.* He met with a small direct hernia on the left side, which was in continuity with a large pouch between the bladder and pubes. Both sacs opened into the peritoneal cavity by a common mouth in which bowel had become strangulated. In another case he found a large sac on the right side in the pelvis near the bladder. Its entrance was by a rounded, firm, sharp-edged opening close to the internal inguinal ring. No diverticulum had entered the inguinal or femoral canals.[8] Putting these two cases together, Bär concluded that the antevesical pouch was first formed, and that as it enlarged a portion of its anterior wall was bulged into the inguinal canal. As an alternative he suggested that the inguinal and properitoneal pouches may be formed independently, and that by the increase of the inguinal sac the mouth of

[7] Von Linhart also proposed this theory (Krönlein).

the deeper one may be dragged down till the two communicate with one another by a common neck.*

A case, resembling the second, above quoted, from Bär, was described by Dr. Brunner in 1889,[9] and Englisch noticed a small pouch in the vicinity of the inner ring containing omentum.† Peritoneal pouches in the hypogastric and inguinal regions were well known to Rokitansky, who observes of those which contain part of the viscera, that they are upon the borderland between internal and external hernia.

By what means these internal pouches are formed is not apparent, nor have I met with any explanation of the process sufficiently plausible to be reproduced here. In seeking to account for the production of hernia properitonealis Meinhard Schmidt has suggested that the internal ring is congenitally dislocated upwards and outwards, or rather that the mouth of the processus vaginalis is developed in that position.[11] If so, there would be a portion of the processus vaginalis between its inner orifice and the internal ring, at which spot there is generally a constriction (Ramonède). Here we have the properitoneal sac in the embryonic form. The history of development throws very little light on this original displacement of the orifice of the processus. In many of the recorded cases M. Schmidt found that the entrance of the sac was not at the inner ring, but higher up, for which the previous theories give a mechanical explanation. The congenital displacement of the inner ring needs further confirmation.

The herniæ properitoneales are so rare that Krönlein was only able to collect twenty-five, and some of these do not strictly belong to the class in which he has placed them. The antevesical sac is rarer than the intrailiac, and never makes any projection of the abdominal wall beyond the swelling in the canal or scrotum. In the majority of the intrailiac cases also there is no external evidence of the deep sac; but when the overlying parietes are very thin, a tumour is observed on the surface of the belly extending upwards parallel to Poupart's ligament towards the anterior superior iliac spine. This ventral swelling appears to be identical with that which always accompanies interstitial hernia when the viscera are on the surface of the external oblique or between that muscle and the internal oblique.

* Krönlein proposes for these herniæ the name "herniæ diverticuli (sc. peritonei) parieto-inguinalis or cruralis."

† Havage found a hernia containing bowel, internal to the right hypogastric artery. It had not penetrated the fascia transversalis. It contained bowel which had burst into the belly.[10]

Interstitial Hernia with a Ventral Swelling.

Passing now to the consideration of the interstitial herniæ which have a ventral swelling, nothing more need be said of the infinitely rare cases of properitoneal hernia thus endowed. It is not possible to give a separate description of the hernia which lies between the muscles and that on the surface of the external oblique. The general characters of each are similar, and as they probably have essentially the same origin, the two will be included under one clinical division.

Historical Note on Interstitial Hernia.—Perhaps the earliest record of interstitial rupture was made by Thomas Bartholin, who described it under the title of "bubonocele rara."[12] A man, æt. 30, came to him, he says, from Falstria, who had had a tumour of the size of a duck's egg in the left groin since he was fifteen. The man had lately taken a purging medicine at the hands of an empiric, whereby the tumour was so much increased that it exceeded in size an adult human head. It extended upwards towards the spleen; was lax, soft, and painless. "I am not in error," says he, "in supposing it to be a bubonocele from rupture of the peritoneum, with the intestinum ileum protruding. But that the intestines should be rolled upwards by rupture is something extraordinary, unless we may consider the muscles in this part of the hypochondria dilated or unnaturally delicate. I nowhere remember it to be related that in this part the peritoneum is dilated or ruptured and transmits the viscera upwards." The scrotum was quite sound.

Cases were observed afterwards by Petit,[13] Astley Cooper,[14] Allan Burns,[15] and others. Franz C. Hesselbach gives an excellent plate of a dissection taken from the body of a woman, showing the sac lying between the internal and external oblique muscles.[16] M. Goyrand made some valuable additions to the subject; and in this country the surgeons of Guy's Hospital, Mr. Cock,[17] Mr. Bryant,[18] and Mr. Birkett,[19] have been the principal contributors among the earlier writers of our own day. Mr. Birkett was the first to treat of this hernia systematically, and the different varieties were well known to him and described before the works of Streubel[20] and Krönlein appeared on the Continent.

Frequency of Anomalies of the Testis.—Bartholine notices that the scrotum was natural in his patient, but this is far from usual in interstitial hernia among males. Of the 129 cases tabulated in Table XVIII., some abnormality of the testis existed in 73.4 per cent., and in 67.1 per cent. the testis was completely retained or had only partially descended.

In 28 cases the testis could not be found, and was apparently completely retained. In 53 cases the testis was in the canal at some point between the internal and external rings, or in the hernial sac beyond

TABLE XVIII.

Table of Cases of Interstitial Hernia in Males, seen at the Truss Society between 1866 and 1890, arranged according to the Age of the Patient and the Side Ruptured at the first appearance of the Hernia.

	Total.	Under 1	1 5	6 10	11 15	16 20	21 25	26 30	31 35	36 40	41 45	46 50	51 55	56 60	61 65	66 70
Right . .	80	30	3	7	2	7	2	5	1	6	3	1	3	..	...	1
Left . .	38	20	1	3	3	1	1	1	1	2	3	1	.	.	1	.
Double . .	5	3				.	1			.			1	.	.	.
Total .	129	62	4	10	5	8	4	6	5	8	6	2	4	.	1	1

TABLE XIX.

Table of Cases of Interstitial Hernia in Females, seen at the Truss Society between 1866 and 1890, arranged according to the Age of the Patient and the Side Ruptured at the first appearance of the Hernia.

	Total.	Under 1	1 5	6 10	11 15	16 20	21 25	26-30	31 35	36-40	41-45	46 50	51 55	56-60	61 65	66 70
Right . .	22	3		1				3	3	5	4		1	1	1	
Left . .	12						1	2	2	3	2	2			.	.
Double . .	..	..	..	..	.	..	.		.	...				..	...	..
Total .	34	3	..	1	...	...	1	5	5	8	6	2	1	1	1	..

the limits of the canal. It has often been noticed that the hernia may drive down the testis, and the organ, which is retained at one visit, may be in the canal at the next, and eventually may reach the scrotum. When it enters the scrotum, it may remain high up, or may not be fully developed.

Among inguinal herniæ in general, the relative frequency of interstitial hernia in males is .13 per cent., and in females .61 per cent.* Therefore it is relatively more common in women than in men. If, as some suppose, the hernia takes its upward course because the external ring is impassable, the very small and tight external ring of women explains the greater relative frequency of this hernia among them.

Age of Occurrence.—There is a manifest difference between the sexes in regard to the age at which interstitial hernia develops. In the female it arises almost exclusively during the child-bearing period, and is very rare before twenty-five or after forty-five (Table XIX.). In males, on the contrary, it may occur at any age, and a very large proportion of cases appear in the first year of life (Table XVIII.). It will be remembered that, when hernia follows an anomaly of the testis, the higher the grade of the anomaly the larger the proportion of cases in persons under one year, and that when the testis is completely retained 42.8 per cent. appear in the first year. With interstitial hernia, however, 47.6 per cent. are found in persons under one year, as if some anomaly more considerable still were associated with its production.

Among the female cases in Table XIX. the ovary was detected three times in the sac. We have no means, unfortunately, of ascertaining, if the hernia in the living is contained in the canal of Nuck.

Ratio of Right to Left.—In this context may be mentioned the ratio of right to left interstitial, which is 22 : 10 for males and 18 : 10 for females. Notwithstanding that a number of the interstitial herniæ are in persons with the testis in the scrotum and fully developed, which should tend to lessen the ratio, it is yet the same as is found among those with the testis retained in the canal or abdomen (Table IX.).

Double Interstitial Hernia.—Interstitial hernia so rarely comes on both sides at once that it was only observed at the Truss Society in one woman and in five males. It is, of course, common enough to find an oblique hernia on the other side.

The Characters of Interstitial Hernia.—It should be observed that interstitial hernia, unlike the subdivision called "properitoneal," seldom enters the scrotum,† and when it does so, it is not till the abdominal swelling has attained considerable magnitude. If the testis has not

* Twenty-three cases were found among the males in Table I., and eleven among the females in Table II.

† This circumstance was only noted in nine of the 129 cases in Table XVIII.

cleared the external ring, the corresponding half of the scrotum is not developed, but a flat band of tissue, the remains of the gubernaculum, can generally be traced passing from the canal over the crest and body of the pubes.

An interstitial hernia is depicted in Plate VIII., for which I have purposely chosen a case not very far advanced, because the bulk of a larger tumour is apt to obscure its topography. In this instance the viscera were beneath the external oblique, and the testis, which was very small, was within the external ring. Here is seen the characteristic, flattened, oval tumour, parallel to Poupart's ligament, mounting upwards towards the flank, and projecting not far beyond the surface of the abdominal wall. When the patient has taken no pains to control the rupture, or when the parietes over it are thin, the tumour forms a much greater prominence and rises far beyond the limits shown in the plate. Several cases were met with in which the swelling reached the costal arch and extended inwards to the middle line. Herniæ of this vast size resemble, as one writer has said, "a second belly."

When a part of the hernia descends into the scrotum, a groove, corresponding to the external ring, marks the division between the two portions. The testis, which is often in the hernial sac, is sometimes carried upwards, and may rest near the anterior iliac spine. After reduction of the protrusion the cord can be felt entering the aperture of exit. This opening is generally in the position of the inner ring, but Meinhard Schmidt contends that it is placed much further outwards or higher up. In the cases where this occurs, it may be due to the yielding of the ring on the side towards which the hernia travels, just as in scrotal hernia the inner ring tends inwards. M. Schmidt, however, does not accept this explanation. In order to effect reduction the protruded parts have to be pushed downwards and inwards toward the canal and external abdominal ring, but the proceeding is always difficult, even when the opening into the belly is large.

Anatomical Relations of the Sac.—The anatomical position of the sac in most of the recorded cases and museum specimens is between the external and internal oblique muscles. Goyrand described a small sac which was between the external oblique and fascia transversalis, with the internal oblique and transversalis muscles above it.[21] In Hartung's second observation he thought the sac to be between the transversalis muscle and fascia.[22] In Meinhard Schmidt's dissection, the sac presented itself after the division of the external oblique.* Behind the sac the internal oblique did not exist in its ordinary form. The bed on which the sac lay, and with which its deep surface was in contact, was

* *Loc. cit.* The same disposition of parts was noted in Bourdon's case. (Bull. de la Soc. Anat., 1842, xvii.–xviii. p. 223.)

Interstitial Hernia. The right half [illegible] Scrotum is absent and the Testis [illegible] small lies within the canal [illegible] The External [illegible] [illegible]

a very thin, translucent membrane covered with sparse, atrophic muscle fibres. The same author remarks upon the thinness, on "the obliteration of the layers," of the abdominal wall over the tumour. This is chiefly noticeable below a horizontal line through the anterior superior iliac spine. It concerns sometimes the external oblique as well as the deeper muscles. In a greater or less degree it seems to be a constant feature in the interstitial herniæ now under consideration.

When the sac rises on the surface of the external oblique that muscle is not usually imperfect, except over the inguinal canal.* In six cases of the kind which have come under the author's notice, the external ring was enlarged to such an extent that it coincided at its outer part with the deeper opening, which was also capacious. There is thus an aperture leading directly into the abdomen very like that in direct hernia. In dissecting an old woman with interstitial hernia, Allan Burns [23] found the external ring widely dilated; and Golding Bird makes much the same observation.[24] But others, though not denying the fact, are not so explicit. In the record by Mr. Hulke [25] of a case of double interstitial ascending on the external oblique, no mention is made of the external ring, nor does Fano say anything of its enlargement.[26]

The imperfection in the abdominal wall sometimes extends far beyond the limits of the inguinal canal. I have met with a hernia in a man, æt. 56, dating from his first year, in whom Poupart's ligament and the adjacent parts of the abdominal muscles between the pubic spine and the internal ring seemed absent, so that a large semi-elliptical gap led directly into the abdomen. The rupture rose on the belly and overhung the thigh.

In another patient who had had a rupture during forty-five years of his life, and had never used means to control it, the swelling reached nearly to the right costal arch, and slightly overlapped the rectus muscle. On reduction, the abdominal wall, below the level of the anterior superior iliac spine and external to the rectus, was felt to be deficient, and a membrane occupied all the space down to Poupart's ligament. The opening into the abdomen was near the site of the inner ring, but was rather wide. No vestige of the external ring could be found. The right scrotum was absent, and the testicle, equal in size to a filbert, lay just one inch internal to the anterior superior iliac spine. Above the deficiency in the muscles the sac could be felt between the skin and the aponeurosis. In such cases it may be supposed that the muscles are represented by membrane, as sometimes happens at other parts of the abdominal wall (See Chapter XXIX. On Ventral Hernia).

Interstitial Simulating Femoral Hernia.—The ventral swelling of

* Cases with the sac on the aponeurosis of the external oblique have been included with the interstitial herniæ by Küster. (Langen. Arch. f. klin. Chir., 1887, vol. xxxiv. p. 202.)

interstitial hernia is not always confined to the area of the abdomen. When it becomes prominent, it may fall over on the thigh, and at first sight simulate femoral hernia. An instance of this is seen in Plate IX. Here the sac lay partly between the external and internal oblique, but the greater part of it protruded through the large external ring, and at length fell over on the thigh. The testis, which was retained till the age of thirty-five, when the rupture first came out, was very small, and lay at the lower part of the sac. It is usually in cases where the sac has rested on the aponeurosis of the external oblique that it falls down over Scarpa's triangle, but sometimes this happens, as in the case here delineated, though the sac is to some extent between the muscles.

Mode of Formation. The difficulty which Bartholin experienced in explaining why the viscera should rise upwards has also perplexed every subsequent observer. It cannot be questioned that the sac will enlarge in the direction of least resistance. Mr. Hulke and others have supposed that the resistance met with at the top of the scrotum, or at the external ring, obliges the viscera to take another course; and it will be remembered how often the testis is retained in these cases, and that therefore neither the external ring nor the scrotum have suffered dilatation. But these herniæ may occur with a full-sized testis in the scrotum, as M. Broca has so ably demonstrated.[27]

If the hernia owes its origin to a "congenital dislocation of the inner ring," or to arrest in the development of the testis, we are not familiar with any stage in development which manifestly favours its production. If it were dependent upon a circumstance of this kind, we should expect to find it not unfrequently among those with anomalies of the testis; and yet of the 457 persons cited in Chapter VI. as having hernia in conjunction with anomalies of the testis, only 23 had interstitial hernia. Surely some additional factor is requisite to determine this kind of protrusion.

If we seek for the principal difference between interstitial and those herniæ with anomalies of the testis, we find it in the condition of the parietes. I have drawn attention at some length in the preceding pages to the delicate membranous state of the abdominal walls about the inguinal region. Here is a difference between interstitial and other herniæ which is common and which is real. If the imperfection of the abdominal wall, so often noticed with these herniæ as existing in greater or less degree, is their original cause, it does not militate against the supposition that a large proportion are attended with anomaly of the testis. On the contrary, when that organ is defective, it is very probable that the parts through which it passes, and with which it is so intimately related, will be likewise deficient, more especially as the anomaly of the testis in these cases is generally of a high grade.

Plate IX

Interstitial Hernia, falling over the thigh and simulating Femoral Hernia, in a man æt. 56

Danielsson & Co. sculp

When the sac ascends upon the external oblique, a gap is usually, if not always, present in that muscle, so that the external and internal rings coincide. It is as if the anterior wall of the canal were absent. The hernia cannot descend upon the thigh on account of the attachment of the abdominal fascia to Poupart's ligament; and if it meets resistance at the entry of the scrotum, it must ascend and continue to enlarge until the opposition to its advance in that direction is greater than that towards the scrotum.

The mode of formation of the hernia when it rises up between the muscles is more difficult of explanation. The external oblique in such cases does not appear to share the imperfection which, it may be supposed, affects the deeper muscles. When the hernia passes the inner ring and enters the canal, if the internal oblique and transversalis are membranous and the external oblique sound, the enlargement of the hernia is almost necessarily in an upward and outward direction, that being the direction of least resistance. In many cases, however, the external oblique also is thinner than usual. When the hernia has reached so high that the resistance is greater upwards than downwards, it will begin to dilate the external ring and descend to the scrotum. An observer may thus find the external ring enlarged, and conclude that the upward course of the hernia cannot have been due to obstruction at that point; but he fails to take into account past occurrences. Interstitial hernia does not always protrude early in life, particularly in women, and therefore a congenital imperfection may not appear of consequence in the etiology of the disease; but I have endeavoured to explain in some measure in Chapter XI. how time alters defects long dormant.

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CHAPTER XIX.

ON HERNIA OF THE OVARY, FALLOPIAN TUBE, AND UTERUS.

Earliest Record of Hernia of the Ovary.—The first monograph on hernia of the ovary was written by Deneux, a French obstetrician, in 1813.[1] The earliest notice of this displacement he traces to Soranus of Ephesus; but the passage, as it occurs in Oribasius, is far from clear, and may simply mean that the ovary was found among the contents of the sac in an ordinary hernia.

Distinction between (I.) Hernia of the Ovary with Intestine, and (II.) Intestinal Hernia with the Ovary.—This is not what is usually implied by the term hernia of the ovary. In general the ovary first descends, and either remains alone, or is followed by some of the other abdominal viscera. But an intestinal hernia may be formed, and as it increases, may add to its contents the neighbouring ovary. Thus there are two forms of this hernia, of which the first is by far the most common.

I. Hernia of the Ovary.—Descent of the Ovary.—The descent of the ovary closely corresponds with the descent of the testis in the male, and some of the more important events in the process may here be referred to with advantage. After lying at first vertically in the lumbar region, it begins, about the sixteenth week of fœtal life, to change its direction and its position. It is then placed somewhat obliquely, and its lower end, directed inwards, is entering the iliac fossa. Towards the twentieth

week its axis is nearly horizontal, and it rests almost entirely in the iliac fossa. At the eighth or ninth month of fœtal life it is quite horizontal, with its outer half still in the iliac fossa, and the inner half at the entry of the pelvis. Long after birth it maintains this position, and towards the tenth year proceeds to its final destination. These limits of time are very variable, and sometimes the organ is found in the pelvis in the first year. The left ovary is generally a little in advance of the right. The round ligament, under normal circumstances, instead of shortening, like its analogue the gubernaculum testis, lengthens. Thus the ovary is favourably placed during a long period for making its escape by the inguinal canal, and much the same mechanism is provided for it as for the testis in the male.[2]

Changes of Position due to Pregnancy.—In adult life the ovary may regain its position in the iliac fossa, as a result of pregnancy. The organ rises with the uterus into the abdominal cavity, and directly after parturition occupies the inner part of the iliac fossa, where it sometimes is held by adhesions throughout the rest of life,[3] and thus it may again come within the range of an ordinary hernia.

Ectopia of the Ovary—Period of its Descent.—The period at which the ovary makes its appearance externally, in consequence of defect of development, is somewhat uncertain. Puech thought the time most favourable for this transition was the twentieth week of fœtal life.[4] Of the cases discovered after birth, the majority are observed in the first few weeks or months, though some, it seems, have appeared so late as the tenth year. (See Tables XX., XXI.) This corresponds very well with what was said above as to the position of the ovary during the first ten years of life.

Whether the ovary ever defers its descent till after puberty is very doubtful. In cases where such an allegation is made, it is probable that the ovary came down in early life, and was not noticed till some uneasiness was felt, or till intestine was protruded above it.

State of Development of the Ectopic Ovary.—Whether the ovary fails to reach the normal size, when it is outside the abdomen, as so often happens to the testicle when arrested in its descent, it is not possible to determine during life. Firstly, because the majority of the cases are seen in childhood before the organ can have attained its full development; and secondly, because the adult ovary, even in full activity, is subject to much variation in size in different individuals. It is, however, probable, that the ovary, when it appears externally, is sometimes incapable of function, and necessarily so when it is associated with imperfect development of its excretory channels.

Ectopia in conjunction with Defective Development of its Excretory Channels.—As to the frequency of the conjunction of these

anomalies, it is found from the records bearing upon the subject that double ectopia is attended with defective development of the uterus, vagina, or Fallopian tubes in the majority of instances, and that a normal uterus is quite the exception.[5] With ectopia on one side, though the greater number of cases have a normal uterus, those with abnormal uterus are only a little less numerous than those with a normal uterus. Hence it might be concluded that defect in the excretory channels is the rule in cases of ectopia of the ovary. That this is true of the adult, to whom the records above quoted almost exclusively refer, is probable; but it is very doubtful whether the rule holds good in childhood, when ectopia most frequently exists.

Ectopia a Transitory Condition of Childhood.—Of the cases observed at the Truss Society during the last twenty-five years, very few were found after the first five years of life. From a comparison of Tables XX. and XXI. with Table XXII. it may be inferred that in the majority of cases the ovary returns into the abdomen, and that in a few only the organ remains external after puberty. Ectopia, therefore, appears to be in most instances a transitory condition of early childhood, and the persistence of the defect up to adult age to be generally associated with arrest of development of kindred organs.* Only two cases of double ectopia in women were seen at the Truss Society, and neither of them had ever menstruated; one of them had no pubic hair, and her external genitals were like those of a child.

The ovary is frequently accompanied by bowel or omentum. In Puech's list the intestine was seldom found with the ovary, but in Tables XX. and XXI. the cases where this occurred are a little more numerous than those where it did not.

Effect on the Position of the Uterus. With ectopia of the ovary the uterus, when present, suffers a displacement which alters its position in three ways. It is drawn forwards and inclined to the affected side, and likewise undergoes a certain amount of rotation, so that its posterior surface looks towards the side on which the anomaly exists. In double ectopia the uterus is raised, and one author believes this upward movement to be so considerable as to take the organ out of reach of the finger in the rectum.

Condition of the Canal of Nuck. Many observers have neglected to record the condition of the canal of Nuck in these cases, but it is stated to be usually open, and only occasionally is closed to the abdomen. That there is a relation between patency of this canal and the position of the ovary has been shown by Sachs, who noted the condition of the processus when the organ was in the true pelvis and when it was in the iliac fossa.[7] In the first case the canal was patent in 12 per cent.,

* In such cases the extruded organ is commonly a testis, not an ovary.[6]

TABLE XX.

Cases treated at the Truss Society during twenty-five years (1866 to 1890 inclusive) in which Intestine or Omentum was found with Hernia of the Ovary. The Patients are arranged according to their Ages when the Intestinal Hernia was first noticed.

Inguinal Hernia.	Total.	Under 1	1–5	6–10	11–15	16–20	21–25	26–30	31–35	36–40	41–45	46–50	51–55	56–60	61–65	66–70
Right ovary down—Right	45	27	7	2	...	1	4	1	...	1	1	...	...	...	1	...
Left ovary down—Left	37	30	3	...	...	1	1	2	...	...	...	...	...	...	...	...
Both ovaries down—Double	13	10	2	1	...	...	...	...	...	...	...	...	...	...	...	...
Total	95	67	12	3	...	2	5	3	...	1	1	...	...	...	1	...

TABLE XXI.

Cases of Hernia of the Ovary without Intestine or Omentum, treated at the Truss Society during twenty-five years (1866 to 1890 inclusive), arranged according to the Age of the Patient at the time of her visit to the Society.

	Total.	Under 1	1–5	6–10	11–15	16–20	21–25	26–30	31–35	36–40	41–45	46–50	51–55	56–60	61–65	66–70
Right	44	25	9	2	...	2	1	2	1	1	1	...	...	...	...	...
Left	31	20	8	1	...	...	1	...	1	...	...	...	...	...	...	...
Double	4	3	1	...	...	...	...	...	...	...	...	...	...	...	...	...
Total	79	48	18	3	...	2	2	2	2	1	1	...	...	...	...	...

TABLE XXII.

In this Table the Cases in Tables XX. and XXI. are combined, and are arranged according to the Age of the Patient at the time of her visit to the Society.

	Total.	Under 1	1–5	6–10	11–15	16–20	21–25	26–30	31–35	36–40	41–45	46–50	51–55	56–60	61–65	66–70
Ectopia of right ovary	89	42	17	7	1	4	3	3	5	2	2	1	...	...	1	1
,, left ovary	68	44	17	1	...	...	1	1	2	1	1	...	...	...	...	...
,, both ovaries	17	10	4	1	...	1	...	1	...	...	...	...	...	...	...	...
Total	174	96	38	9	1	5	4	5	7	3	3	1	...	...	1	1

and in the second in 24 per cent., and therefore the canal is open much more frequently when the ovary has not completed its descent than when it occupies its normal situation. There is thus additional probability that the sac in which the ectopic ovary lies is commonly in communication with the peritoneum, and that the intestine or omentum which sometimes follows it enters the same cavity. When this takes place, the hernia corresponds to that in the tunica vaginalis in the male.

Incidence of Right and Left.—According to the observations of Mr. J. Langton and Dr. Puech, the left ovary is more frequently outside the abdomen than the right.* Puech thought that the descent of the left ovary a little in advance of the right, which takes place in normal development, accounted for the more frequent appearance of the left externally; but the same difference of level occurs during the development of the two testes, and in the case of these organs is usually referred to in explanation of the larger proportion of anomalies on the right side. It is thus obvious that this fact involves a contradiction, unless hernia of the right ovary preponderates over that of the left, and such is the result when it is obtained from a larger number of cases than was used by these authors. In Table XXI. the ratio of right to left is 1.3 : 1; but if the cases from birth to ten years of age are taken, the right and left sides are nearly equally affected.

Position of the Ovary in Relation to the Inguinal Canal.—The position of the organ may be inside or outside the external inguinal ring, and when no hernia of the intestine is present, the number within is equal to the number without the canal, both in adults and children. But when the bowel also descends, the majority of the ovaries are found in the labia, and this difference is due no doubt to the effect of the additional protrusion.*

Reducibility of the Ovary.—Whether the ovary is inside or outside the inguinal canal, it may sometimes be reduced into the abdominal cavity. At all ages it is more commonly irreducible than reducible, but there is a great difference in this respect between the child and the adult. Among the cases in Table XXI. the ovary was reducible in 48.6 per cent. in the children, and in only 15.3 per cent. in the adults. It is

* Hernia of the Ovary	Ovary within Canal.	Ovary outside Canal.
Children	34	35
Adults	5	5
Hernia of Ovary with Intestine.		
Children	21	58
Adults	6	10

* From cases observed at the Truss Society.

certain that in many cases the irreducible ovary in children returns under the use of a truss, and it is probable that in the majority the organ returns either spontaneously, or as the result of treatment.*

The Ovary with other Viscera.—It has already been remarked that the congenital cases which have been under consideration hitherto are oftentimes complicated with intestine or omentum. An examination of Tables XX. and XXI. shows that when the bowel comes down, it usually makes its appearance very early in life; but as the number of cases without enterocele is nearly equal to that with enterocele, the anomaly of the ovary cannot have a very decisive influence on the descent of the intestine. Among inguinal herniæ in females, hernia of the ovary is present alone, or with other viscera, in 1.2 per cent.†

II. Intestinal Hernia accompanied by the Ovary.—Little need be said of that rarer class of cases where the ovary has formed part of the contents of a hernial sac. It has been met with in inguinal, femoral, umbilical, ventral, vaginal, and ischiatic herniæ.

Hydrocele of the Sac occluded by Ovary or Fallopian Tube.—Neboux relates that he found the ovary engaged in the internal abdominal ring, and the hernial sac distended with fluid.[9] Camper likewise, in dissecting an old woman, saw the ovary closely adherent to the right femoral ring, and much fluid in the hernial sac. He supposed that in this way a hernia might undergo spontaneous cure.[10] A case nearly allied to these occurred to M. Berard.[11] The woman, æt. 45, had had a femoral hernia for two years. It became irreducible, but increased gradually in size. It was painless, but so large, that the fluid in the sac, which amounted to 7 or 8 lbs., was let out. She died of peritonitis after the tapping, and at the mouth of the empty sac the Fallopian tube was found closely attached to the borders of the right femoral ring.

Ovarian Cyst in Hernial Sac.—Casati records the case of a young woman in whom a fluctuating swelling appeared in the left crural region. It soon increased to the size of an infant's head, and in the iliac fossa another swelling was detected, between which and that in Scarpa's triangle fluctuation could be obtained. The cyst in the groin was punctured, and 2 litres of chocolate-coloured liquid let out. In two months, as it had refilled, it was again tapped, and iodine solution was injected, after which the swelling disappeared. Casati regarded this as an ovarian cyst escaping by the femoral ring.[12]

The Symptoms of Hernia of the Ovary differ according to the age of the patient. In the child, a small, oval body, somewhat elongated

* The difference in the comparison of the parts of Table XXII. with one another, and Table XX. and XXI. with one another, indicates the probable disappearance in early life of the herniated ovary.

† Among 1803 cases in Table II., there were 23 of hernia of the ovary.

and well-defined, occupies the inguinal canal or labium, and a thin cord, proceeding from its upper end, can be traced to the internal ring. It feels solid, and if punctured is proved to be so. It is freely movable, and can generally be reduced into the canal, but not always into the abdomen. If an enterocele is present, the ovary is usually felt after reduction of the gut. The diagnosis is not difficult, for in the infant there is scarce anything with which this organ can be confounded. That it is not a cyst is certain, for it gives no sense of fluctuation. A piece of omentum with a narrow neck may simulate the ovary, but this condition is very rare in the child, and the younger the child, the more rare is the omentum. In the adult, though other signs are available, there is more likelihood of mistaking the omentum or fat for the ovary. The most important means of diagnosis, which was suggested by Lassus, consists in producing movement in the ovary by moving the uterus with the finger, introduced into the vagina or rectum.[13] The application of this method is obviously limited, and another principal sign is not constant. The ovary enlarges at the menstrual period, and becomes tender and painful. But these patients do not always menstruate, and when they do the external ovary does not always become sensitive. The size of the organ also varies considerably in the adult. So that for all these reasons there is more doubt attending the diagnosis in grown persons than in children.

Hyperæsthesia of the Ovary.—The normal ovary, according to Puech, is insensitive, and the behaviour of the majority of those external to the abdomen confirms his statement, but now and then a herniated ovary becomes exceedingly tender and painful. Several persons have suffered removal of the organ on this account. The discomfort may vary from slight tenderness on palpation to a hyperæsthesia so intense as to oblige the patient to walk lame, in order to obviate the pressure of the abdominal muscles. Lassus and Guersant had cases of this kind.[14]

It has been debated whether ovaries, thus affected, should be returned to the abdomen or removed. Puech concludes that they should not be removed unless manifestly morbid.[15] It is only in the case of the adult that the question arises, and as the functional value of the ovaries which remain external after puberty is doubtful, and as the risk incurred by taking them away can hardly be greater, if so great, as that of returning them to the abdomen, there seems to be no sufficient reason to recommend their preservation.

Hernia of the Fallopian Tube.—In a few instances the Fallopian tube has been found alone in an inguinal or femoral sac. Lavater says (1672) that Bessier, a French surgeon, found with the intestine the Fallopian tube in the groin, and several such instances have been since recorded.[16]

Hernia of the Uterus.—The uterus sometimes forms part of the

contents of a hernia. It may follow the ovary or Fallopian tube, and Cruvelhier thought this sequence to be invariable. Others have supposed that during the enlargement of an ordinary hernia the peritoneum of the sac may draw upon the broad ligament and thus displace the uterus.

The organ is sometimes small and ill-developed. It may be bipartite, and one cornu may be protruded, or it may be normal in size and function.* The imperfect uterus is not always found in a congenital sac, for Krönlein met with it in an obturator hernia. Whatever its condition it generally enters the inguinal canal. Brunner, who has treated the subject at great length, has only collected two femoral cases, one of which is doubtful.† [17] The uterus has also escaped at the umbilical and ischiatic openings. A fœtus has been developed in the protruded part, as before mentioned, and in two cases has been cut out with the survival of the mother. Except when the womb is pregnant in the sac, its presence is very difficult to ascertain with certainty. Brunner suggests that bimanual examination and the passage of a sound might facilitate the diagnosis in cases not strangulated.

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* J. Boeckel of Strassburg operated upon a "young man" who had suffered great pain from an inguinal hernia which had existed from birth. "On opening the sac, which was empty, and pressing the parietes above it, a white, glistening, oval body was forced out of the external ring. A fringed structure lay close to it. These parts were cut away below a ligature, and were found to consist of a bicornute uterus containing a true endo-metrium with ciliated epithelium, a Fallopian tube and a testis bearing an epididymis and a distinct vas deferens and a broad ligament. In all other respects the subject was male." (Br. Med. Jour., May 7, 1892, i. 75, from the Sem. Méd., April 20, 1892.)

† I am principally indebted to Dr. Brunner's essay for the remarks in the text on hernia of the uterus.

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CHAPTER XX.

ON FEMORAL HERNIA.

Historical Outline.- Among the mediæval surgeons only one appears to have been aware that ruptures may enter the thigh. This was Guido de Chauliac.[1] After him the fact seems to have been lost till Nicolas Lequin mentioned it in 1665, and showed that he was well acquainted with its position and with the difficulty of treating it.[2] At the end of the eighteenth century Philip Verheyen[3] gave a short and imperfect description of femoral hernia in his work on anatomy. A. Le Quin, the nephew of Nicolas, again mentioned it a few years later.[4]

The celebrated French surgeons at the beginning of the last century were well conversant with it, and among them Garangeot claimed to be the first to write an account of it.[5] He was anticipated, however, by B. D. Mauchart, who described the rupture in 1722 in an Essay on Incarcerated Hernia, and his observations, though sometimes faulty, are equal if not superior to those of Garangeot.[6] Both these writers describe the hernia as descending in front of the femoral vessels, and this error appears to have long held sway, for, though Bassuel[7] in 1734 pointed out that the sac is placed in the angle between the crural arch and the pubes, we find it repeated in 1748 by Arnaud.[8] Towards the end of the century Don Antonio de Gimbernat[9] again directed the attention of the profession to the crural ring and its boundaries, and imparted his

observations in a small tract, which, if its value may be measured by its effects, is the most important of all writings on femoral hernia. Before his time it had usually been the practice to divide the stricture upwards in strangulated femoral hernia, and though this might be done with impunity in the female, the incision frequently severed the spermatic artery in the male and caused death by hæmorrhage. This great benefactor of the ruptured explained his method of operating in 1777 upon the living body, but had previously demonstrated in 1768 the attachments of the crural arch. His doctrine, which has generally met with acceptance and approbation, gained ground somewhat slowly at first, and its rejection by Sir Astley Cooper is one of the few blemishes in that otherwise admirable work.

Ordinary Place of Descent and Coverings.—Femoral hernia descends behind the crural arch, between the femoral vein and Gimbernat's ligament.* In its progress outwards the sac carries before it the subperitoneal tissue, the septum crurale of Cloquet, the femoral sheath and the cribriform fascia, which is a part of the fascia lata. In a fully formed hernia the three last structures constitute a single, well-defined, fibrous capsule, to which Sir Astley Cooper gave the name of "fascia propria." Beneath the fascia propria is the subperitoneal fat and peritoneum; over it is the subcutaneous tissue and skin. The coverings of a femoral hernia thus considered are of real practical importance in the operation for strangulation.

Sac over the Femoral Vessels.—The next most common situation, though a sufficiently rare one for a femoral protrusion, is over and a little external to the femoral vessels. This usually presents itself as a bulging of the abdominal wall and adjacent part of the thigh at the place indicated. The prominence appears on cough or during straining, but subsides when the patient is at rest. A considerable amount of pain attends this condition at times which renders instrumental support necessary. A true sac does not apparently form, as a rule, in these cases, but there are some in which a sac of an ordinary type descends into the thigh in this unusual position.

Sac external to the Vessels.—Velpeau gives an instance in which the hernia passed into the thigh for 1 inch below Poupart's ligament, external to the epigastric artery, and contained a portion of the colon.† [10] Partridge saw a femoral hernia external to the femoral vessels on each side. That on the left contained the sigmoid flexure of the colon, that on the right the cæcum and its appendix.[11] Demeaux saw two sacs, one internal and one external to the epigastric artery.[12]

Sac through Gimbernat's Ligament.—It is still less common to find

* The "hernie crurale moyenne" of Velpeau.

† This is the "hernie crurale externe" of Velpeau.

a sac protruding through the fibres of Gimbernat's ligament.* This peculiar hernia was observed by Langier in 1833, and Legendre collected five other cases.[13] The relation of the hernia to the ligament through which it comes may be seen in Fig. 1, Chapter XI., where a band of tissue intervenes between the neck of the sac and the crural ring.† In cases of this kind the swelling in the thigh is small, as a rule, and more to the inner side than in the ordinary form. Cruvelhier saw in an old woman two hernial sacs coupled: one came by the femoral ring, and the other through Gimbernat's ligament.

Sac behind the Crural Sheath.—There is a fourth variety of femoral hernia which was described by Cloquet as entering an aperture in the posterior wall of the femoral canal and resting upon the pectineus muscle, behind its overlying fascia.[14] Only three other cases were found by Legendre.[15] Roustan has given an excellent description of a hernia of this kind which he found in a male, æt. 83, on the left side. An ordinary femoral hernia lay in front of the pectineal sac, and concealed it. When the femoral ring was viewed from within the abdomen, the orifice of the deep sac was hidden by a cord of omentum entering the ordinary hernia. The fascia lata over the pectineus was fixed internally to the spine of the pubes, externally to the sheath of the femoral vessels. Between these attachments, at the middle part, it was detached from its insertion at the ligament of Cooper (the ileo-pectineal line), and the peritoneum had descended between that ligament and the detached edge of the fascia. On further dissection the sac was found to be in the substance of the pectineus muscle, and to reach down nearly to its insertion on the femur. The hypogastric artery was at the inner side of the neck.[16]

Allan Burns discovered and described a case in which one sac entered the femoral canal and the other the sheath of the vein. In this instance the obturator artery arose by a common trunk from the external iliac and arched over the outer sac to descend between the two sacs to the pelvis.[17]

The Ordinary Femoral Hernia leaves the abdomen by the crural ring, enters the short canal of that name and emerges at the saphenous opening, raising up or penetrating the cribriform part of the fascia lata. Whilst the sac in the early days of its formation occupies the crural canal, it has not acquired such close adhesion to the parts about it as to prevent its reduction after the contents have been returned to the belly. Many instances are on record in which the empty sac was found reduced within the abdomen.

The femoral ring, in the erect posture, is nearly horizontal, so that at

* The "hernie crurale interne" of Velpeau.

† The neck of the sac is sometimes external and sometimes internal to the hypogastric artery.

first the axis of the hernia is almost perpendicular; but as the sac advances it changes its course in the direction of least resistance, and comes forwards at the saphenous opening, where it forms a small rounded swelling with a circular outline. Under this guise femoral hernia presents itself in the majority of cases. It is important to notice the relation of the tumour to Poupart's ligament and to the pubic spine. The attachment of the subcutaneous and deeper tissues to Poupart's ligament produces a shallow groove on the surface of the groin which marks very clearly in most persons the position of the ligament. The groove is plainly seen in Plate X., in which is delineated the common form of femoral hernia now under consideration.

The hernia is below this groove or fold of the groin, against which the upper margin of the swelling rests. The hernia in this instance does not rise over Poupart's ligament on the abdominal wall, as it is generally said to do. The majority of authors make this asseveration without saying whether they are repeating it from the writings of others, or speaking from personal observation. According to my experience, it is the exception and not the rule for a femoral hernia to mount up over Poupart's ligament, and therein I agree with Malgaigne, who at first held the popular belief, but afterwards recanted that opinion.[18]

Diagnosis.—The upper edge of a femoral hernia touches, but does not obscure, the fold of the groin, and it is seldom that a person is met with in whom a diagnosis of this kind of hernia cannot be made by inspection alone; and when inspection fails, if a line be drawn from the anterior superior iliac spine to the spine of the pubes, the tumour will be below that line.

The spine of the pubes is easily found in the male by invaginating the scrotum and feeling the outer pillar of the external ring which is attached to that process. In the female it is often not possible to feel the external ring. If then the knee is raised and the adductor muscles are put in action, the spine of the pubes is found to the outer side of the origin of the long adductor. Where this also fails, as fail it will in a very fat person, we must attend to the following considerations. The lower part of the abdomen in stout bodies is crossed by a fold or crease in the skin which runs close above the symphysis pubis. It is the lower of the two creases which are seen in Plate X. If the finger is placed on this fold in the middle line it rests upon the symphysis, and thence the bone may be traced outwards to the pubic spine. A femoral hernia is below and external to that process, as Sir Astley Cooper noticed long ago. The relation of the tumour to the spine of the pubes and to the fold of the groin are the two principal means of detecting a femoral hernia. Some have sought aid by depressing the abdominal wall above Poupart's ligament, and feeling the band of omentum or mesentery going

to the crural ring. This cannot always be felt though a hernia is present, nor can it always be distinguished from a chain of lymphatic glands in the iliac fossa. It must therefore be deemed an unreliable and inconstant sign.*

Variations in the Shape and Position of the Sac. A femoral hernia may increase to a large size and still keep its hemispherical shape, as is seen in Plate XI. Even here, though the tumour is so considerable, it does not rise over Poupart's ligament. To the outer side it overlaps the femoral vessels, and at the inner side comes in contact with the scrotum.

When a femoral rupture attains large dimensions, it may extend in various directions. It may make its way down the limb and reach the middle of the thigh. Klinkosch saw one nearly as low as the knee,[20] and in the museum of St. Thomas's Hospital is a model of a hernia which descended to within 1 inch of the knee.[21] Sometimes the protrusion, which goes downwards, forms a long, narrow, flattened cylinder, passing beyond the apex of Scarpa's triangle. The author has seen a protrusion of this kind, 1½ to 2 inches wide, in a woman, æt. 42, descend to the middle of the thigh. After passing the apex of Scarpa's triangle it turned inwards over the border of the limb to reach its inner aspect. Secondly, the rupture may extend outwards and skirt Poupart's ligament, as in Plate XII. It will be observed that the tumour transgresses very little the line of Poupart's ligament.

A third deviation of the sac, which is the most embarrassing of all, is that where it passes inwards or inwards and upwards.

Marjolin saw a femoral hernia enter the scrotum. A woman, æt. 48, came to the Truss Society with a large femoral protrusion, part of which spread out towards the anterior superior iliac spine, and part entered the labium. Stokes of Dublin has described a similar case upon which he operated.[22]

Mr. Golding Bird recorded a case of femoral hernia in the thigh sending a process to the labium, but the patient had suffered the operation for strangulation fourteen years before.[23] After operation, herniæ may assume all manner of fantastic shapes, so that it is then impossible to classify them. The history and the scar determine their nature when doubt arises in these cases.

Again, in extremely rare instances a femoral hernia may rise upwards and inwards, and even transgress the middle line. A man, æt. 40, was seen at the Truss Society with a large globular protrusion on each side. The swellings rose up and met in front of the pubes over the root of the penis, and thus resembled double direct inguinal.

Constrictions and Diverticula of the Sac.—The sac, though occupying its usual position, may sometimes be divided into two or more com-

* Nélaton, Velpeau, Gosselin, and others have laid stress upon this sign.[19]

Femoral Hernia of globular form

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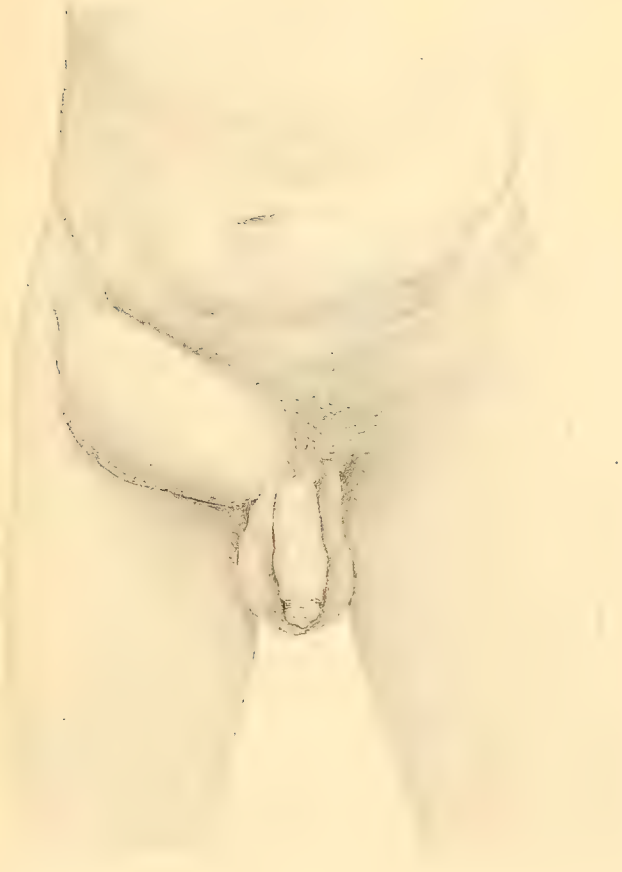

Iliac spine.

partments. I have already referred to a case of Hesselbach's where the hernia seems to have dilated the apertures in the cribriform fascia through which it protruded in five sacculi (Fig. 7). In such a case the hernia must have a lobulated outline. Sacs with two or three diverticula are not very uncommon. Of these, perhaps the hour-glass contraction of the sac is most often met with.* Sometimes a vertical band partly bisects the sac.

Mode of Formation of Femoral Hernia.—Femoral hernia forms gradually in all cases, often imperceptibly. It is accompanied frequently by local pain either of an aching or burning character, like that in inguinal or umbilical hernia. So many women carry it about for years unreduced and unsupported without apparent inconvenience, that it would seem to be a less painful rupture than inguinal. But the pain of a hernia appears to depend rather on the exertions of the patient than on the nature of the protrusion. Pain, moreover, is sometimes capricious in onset, and a rupture which never gave discomfort before, will often become acutely painful without ostensible cause, or when the patient fails in health.

Symptoms.—Among the symptoms peculiar to femoral hernia some authors describe a feeling of numbness and weight in the thigh.† So far as my observation goes, this occurs so seldom, that it is of very little value in diagnosis. Œdema of the limb is also thought to occur, and to be induced by the pressure of the sac upon the femoral vein. This symptom, likewise, if it ever arises from the cause assigned, is so extremely rare as to be of no significance.

Sir Astley Cooper observes that a lymphatic gland often overlies the sac of a small femoral hernia. Chevalier divided a layer of glands $2\frac{1}{2}$ centimetres thick before reaching the sac. The presence of these structures is not so much a symptom of femoral hernia as a circumstance which may prevent its detection. It is important, therefore, to examine the differences between the two. When the glands are multiple there is little difficulty, but occasionally a single gland occupies the site of a femoral hernia and simulates it. Even so, if the hernia is reducible there can be no doubt, but there is much if the swelling cannot be returned. The gland is firm, as the hernia is sometimes. It has a rounded outline, and may have a smooth surface. In all these characters it differs little from a hernia. But it is chiefly upon the difference of attachment that the

* A contraction of the sac may cause it to assume the appearance of having a second neck. Richet operated on a case of the kind, and, after dividing the lower neck, reduced the bowel into the upper compartment of the sac. The true neck was undivided, and held the intestine still firmly in its grasp. (Bull. Soc. Chir., 1858, p. 386.)

† This is mentioned so early as 1726 by D. Koch, who also thought that the pressure of the sac might render the femoral vein varicose.

diagnosis rests. If the scrotum is invaginated and the finger carried outwards to the femoral region, the parts are much more easily felt than if the examination is made only from the front of the thigh, especially if the limb is at the same time flexed. The hernia is deep, the gland is superficial, and can often be caught between the finger and thumb. The gland is movable from side to side, even near Poupart's ligament, whilst the hernia is not.

In women, unfortunately, the examination is less easy, though more often required. Still the gland betrays itself by its superficial position, by the absence of distinct attachment at the upper part, and by its mobility. The surface of a small hernia is rounded, smooth, and well-defined; a gland has not the same distinctness of outline, but sometimes it needs a practised hand to detect the difference.

Frequency in the Population.—The only observation, with which I am acquainted, that gives information on the frequency of femoral hernia in the population, was made by Legendre, who examined 6044 dead bodies, and found femoral hernia to occur in one among every 163.[24] These were adult and generally old bodies.

Age of Occurrence.—Femoral hernia occurs almost altogether in adult age, and is scarcely ever met with under sixteen years. M. Pigné presented a fœtus, of three to four months, to the Anatomical Society of Paris, which had a left crural hernia containing some intestines and part of the liver.[25] Very few details are given of this remarkable case. Depaul presented to the same Society a fœtus of 2½ months which presented an opening at the fold of the left groin by which a large portion of the intestines had escaped. The crural arch appeared raised by the hernial protrusion.[26] The frequent occurrence of this rupture at the later periods of life was attributed by Sir Astley Cooper in part to the fact that the fasciæ are then much weakened by absorption. Women are more subject to it than men, and among women those who have borne children seem to be somewhat more liable than those who have not, or rather the former are more subject both to inguinal and femoral hernia during the child-bearing period, which has been traced in Chapter X. to the effect of parturition.

Hydrocele of the Sac. The sac of a femoral hernia is sometimes distended with serous fluid forming hydrocele of the sac. This may happen when the neck of the sac has become obliterated, but more commonly a small piece of omentum adheres to the neck, and closes it towards the abdomen. The cavity below becomes full of serous fluid, and may increase to a very large size.

In a man, æt. 63, Piéchaud found a hydrocele of the sac which was as large as two fists.[27] A most remarkable case of the kind was under the care of Mr. Kingdon and Mr. Langton in 1872, and was described by

the latter in vol. x. of St. Bartholomew's Hospital Reports.[28] A piece of omentum the size of a walnut occluded the femoral ring. The sac was repeatedly tapped, and was so large that it was no unusual thing to draw off 3 to 4 pints of fluid. A seton was tried without effect, and at length Mr. Langton took the woman into hospital and removed the sac and the omentum.

In the Chapter on Hernia of the Ovary, &c., I have referred to a case in which the sac contained 7 to 8 lbs. of serum, and was closed at its mouth by the Fallopian tube.

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CHAPTER XXI.

ON THE DIAGNOSIS OF INGUINAL AND FEMORAL HERNIA.

Distinction between Inguinal and Femoral Hernia.—When a swelling in the groin or scrotum presents itself for diagnosis, it is necessary to determine, firstly, of what nature is it, and secondly, if it is a rupture, of what kind is it. The principal differences between inguinal and femoral hernia have been already described. There can be no doubt, when the swelling is scrotal or labial; it can only arise when the hernia is in the groin. The relation of the swelling to the fold of the groin and to the spine of the pubes is sufficient in most cases to determine the kind of hernia, whether it be reducible or irreducible.* If it can be put back, the finger may follow it into the canal through which it comes, and this is a great assistance in inguinal hernia. There is practically no difficulty in males, because we can invaginate the scrotum and define the external ring. It is only in women with indistinct "landmarks" that there can be doubt, and it is very certain that in them the signs are sometimes altogether indefinite. I have seen several ruptures which have been operated upon by surgeons to London hospitals where the scar has shown that one kind of hernia was expected and the other was found.

The spine of the pubes must be searched for in one of the three ways before mentioned, and if the finger is placed upon it, the hernia above the spine is inguinal, and that below and external to the spine is femoral. If the position of the internal inguinal ring is found by taking a point midway between the anterior superior iliac and the pubic spines, and half-an-inch above that point, it will then be evident, either that the swelling comes by the inner ring or is placed below and internal to it. Those cases where an interstitial hernia falls over upon the thigh reveal themselves when the tumour is lifted up. The very rare instances in which a femoral hernia runs up to the symphysis pubis or into the labium are not hard to detect, because no known inguinal hernia sends a process into the thigh which dips under Poupart's ligament at the site of the femoral ring.

Enough has now been said in answer to the second question, what kind of hernia is it? I will now consider the previous question, of what nature is the swelling? For many years medical men have been in the

* Throughout this chapter, when irreducible hernia is mentioned, strangulated hernia is not to be understood.

habit of sending cases to the Truss Society to be trussed, and among these it has occasionally happened that persons have come who were not ruptured, but were suffering from some other malady. Thus we possess a series of cases which shows not only the diseases which may be mistaken for hernia, but the relative frequency of these errors.

Diagnosis of Scrotal Swellings.

The swellings below Poupart's ligament which may embarrass the diagnosis of femoral hernia are so much the same in the two sexes, that a single description will suffice for both; but those in the labium or scrotum and those above Poupart's ligament must be examined separately. The scrotal tumours, as they are more liable to misinterpretation than the others, may be taken first. Of the 739 males supposed to be ruptured who came to the Truss Society between the years 1877 and 1888, 541 had swellings in the scrotum.

Hydrocele and its Varieties.—Among them, 233 were hydroceles, and these therefore are mistaken for hernia more often than any other disease. It is evident that the swelling is thought to be a hernia in the tunica vaginalis, because every surgeon, when he examines a scrotal tumour, first seizes the testicle. If he does not find it, he knows that it is within the swelling, or arrested at some point on its way to the scrotum. When the surgeon examines the swelling itself, he perceives a sense of fluctuation, which proves that it contains fluid, and when pressure is made upon it, the contents do not enter the belly. He must therefore suppose the hydrocele to be a hernia in the tunica vaginalis, irreducible and containing fluid. But this is not the end of his supposition, for among irreducible herniæ the bowel is scarcely ever irreducible (see the Chapter on Irreducible Hernia), not more than 9.7 per cent. being in this condition. It is only the omentum that is irreducible among 90.3 per cent. of such herniæ. Therefore the supposition is that the hydrocele is a hernia in the tunica vaginalis containing fluid, and most probably omentum. It is very easy to distinguish between these two conditions. Firstly, because the omentum, or omentum and gut, can be felt through the fluid, whilst in hydrocele there is no solid substance in addition to the fluid. Secondly, because if the spermatic cord is defined above the swelling and passed between the fingers, a solid band is felt extending up the inguinal canal, whilst in hydrocele there is nothing in addition to the constituents of the spermatic cord.

In rare instances a hydrocele occupies the whole of the processus vaginalis, which is closed at the internal inguinal ring and patent below. The spermatic cord cannot then be felt above the swelling. The diagnosis

must rest upon the fluctuation, which can be obtained at all parts of the swelling, and upon the absence in the swelling of any solid matter. If the sac is very tense, so that nothing can be felt of the interior, the upper end is well-defined, and contains fluid in hydrocele; it is ill-defined and solid in hernia. A few records exist of hydroceles which not only reach up to the internal ring, but pass beyond it into the iliac fossa, and form there a second swelling, a "properitoneal" hydrocele.[1] The two parts of the sac are connected by a more or less narrow channel which is in the inguinal canal, or at the internal ring. The properitoneal portion can be felt through the abdominal wall, and fluctuation between the two parts of the hydrocele can be obtained, just as in a case of psoas abscess which has entered the thigh. Lastly, in the so-called congenital hydrocele the fluid fills the whole processus vaginalis, which communicates with the abdomen through a small opening. By pressure the fluid can be driven slowly into the belly. The manner of its return is quite unlike that of hernia, and when part of the fluid has gone back, the sac is lax, and no solid substance can be felt in the interior. It is met with generally in early life, it is a fluid swelling, and there is practically little danger of confounding it with hernia.[*] Those who are so unfortunate as to do so, and to apply a truss, will generally succeed in curing the malady in spite of the faulty diagnosis.

It is commonly said that congenital hydrocele reappears after reduction, when the patient stands up, because the fluid trickles down again from the abdomen, and that light pressure on the inguinal canal prevents the descent of viscera but not of fluid. In this way congenital hydrocele and hernia may be known one from the other. This teaching, though classical, must be accepted with some reserve. The hydrocele, as it usually occurs in the young, has to be distinguished from hernia in the young, and it will be remembered that it is a frequent peculiarity of the hernia of infancy to remain reduced after the contents have been put back. Congenital hydrocele also, in my experience, does not always fill again after reduction during the visit of the patient, so that there is a close resemblance in this respect between the two diseases.

Inflamed Testis.—After hydrocele of the tunica vaginalis, the affection most commonly mistaken for hernia is inflammation of the testis (107 cases in Table XXIII.).

For the present purpose it will be convenient to group together epididymitis and orchitis. There is so little resemblance between these diseases and hernia that it is difficult to conceive how the error arises. Hernia is an indolent swelling, whereas orchitis or epididymitis present signs of inflammation. In the latter the spermatic cord is full, and the vas

[*] It is rare, for among Bryant's cases of hydrocele 3 per cent. were "congenital," and among Melchior's 7.4 per cent.[2]

deferens may be tender and swollen. But nothing is felt besides the constituents of the cord, nor is there any impulse on cough, or any part reducible.

TABLE XXIII.

Table of Cases seen at the Truss Society between the Years 1877 and 1888, which had been mistaken for Hernia.

Males.		Females.	
Diseases probably mistaken for Scrotal Hernia.		*Diseases probably mistaken for Labial Hernia.*	
Hydrocele	233	Cysts of labium	12
Inflamed testis—		Varix of labial veins	6
Epididymitis, 74 / Orchitis, 33	107	Pendulous tumour of labium	1
Varicocele	90	Abscess of labium	1
Encysted hydrocele of the cord	36		20
Indolent enlargement of the testis	28		
Tubercular testis	17		
Tumour of the testis	13		
Hæmatocele	4		
Pain in testis	6		
Lax scrotum	4	*Cases mistaken for Bubonocele.*	
Orchitis during mumps	1		
Perinæal ectopia testis	1	Iliac abscess	3
Tumour in scrotum	1	Exostosis of pubes	2
	541	Lipoma	2
Diseases mistaken for Bubonocele.		Pain in groin	2
Pain in the loin	7	Fluid in canal of Nuck	1
,, groin	5	Sarcoma	1
Retention of testis in canal	3		11
Iliac abscess	1		
Exostosis of pubes	1		
Blood in sheath of rectus	1		
Hydrocele of testis in canal	1	*Cases probably mistaken for Femoral Hernia.*	
	19		
Diseases mistaken for Femoral Hernia or Bubonocele.		Varix of saphena vein	26
		Enlarged glands	22
Enlarged lymphatic glands	115	Abscess in groin	4
Abscess in groin	47	Psoas abscess	2
Varix of saphena vein	9		54
Psoas abscess	7		
Tumour under femoral vessels	1		
	179		
Total males	739	Total females	85

Varicocele.—Though varicocele has more in common with hernia than any other affection, it was mistaken for that disease in only 90 cases in Table XXIII.* It is often accompanied by aching pain in the

* 92.5 per cent. were on the left side ; 5.4 per cent. were on the right ; 2.1 per cent. on both sides. Hasse (Pathol. Anat. Syden. Soc., 1846, p. 45) says that

part, and along the groin to the back; it is worse towards the end of the day. Its soft consistence, and irregular, knotty outline, make it not unlike omentum. The increase in size on rising to the erect posture, the impulse in it on cough, and its easy reduction—all these symptoms tell in favour of hernia. When there is any doubt as to the nature of the swelling, the patient is placed erect, all is reduced that can be reduced, and then pressure is made on the external ring sufficient to prevent the exodus of the viscera. If in spite of this the tumour fills up from below, it is a varicocele. The disease is hardly ever met with before the age of fifteen, and very seldom after forty.

Encysted Hydrocele of the Spermatic Cord is mistaken for hernia much less often than varicocele (in Table XXIII., 36 cases). Almost all the cases were under fifteen, only four being above that age. The fluid is contained in an unobliterated portion of the processus vaginalis above the testis, and may extend from the upper end of that organ to the internal abdominal ring, but usually it is between the external ring and the testis. It is neither painful nor tender. The sense of fluctuation perceived in it shows it to be a fluid swelling. It is not attached to the testis, and is well-defined above. Even when it occupies a part of the inguinal canal it can generally be drawn down, and the cord above it examined. If its upper end is in contact with the abdominal wall it may receive an impulse on cough.

Hydrocele of the Hernial Sac.—There is a condition of hernia closely resembling these cases with which one would expect them to be confounded. The neck of a hernial sac is sometimes obliterated or is closed by adherent omentum, and in either case the cavity of the sac may be distended with fluid. There would be some danger of mistaking the hydrocele of the cord for hydrocele of the sac, but that the former is almost always found in early life, and the latter, as a rule, far on in adult life. With the so-called spurious hydrocele of the hernial sac, when part of the viscera, adherent at the neck, are contained in the cavity together with fluid, the thick solid neck serves to distinguish the case from hydrocele.

If the encysted hydrocele of the cord is situated low down, it may be mistaken for encysted hydrocele of the testis, but there is little likelihood that it will be mistaken for hernia. The hydrocele of the cord sometimes communicates with the peritoneal cavity, and is thus a congenital hydrocele of the cord. Such cases are very rare. Curling collected only four of them.[3] I have met with it but once. The cyst was between the external ring and testis, about the size of a bantam's egg.

Breschet found in 120 cases only one on the right. Curling (*op. cit.*, p. 520) quotes 5639 recruits with varicocele. 86.5 per cent. were on the left side; 6.1 per cent. were on the right; 7.3 per cent. were on both sides.

Whilst it was being examined the fluid passed up into the abdomen by what seemed to be a narrow tube. Melchior twice found the part of the processus vaginalis between the two inguinal rings containing fluid and in communication with the peritoneal cavity. I have not observed that the different cysts in connection with the testis and epididymis are liable to be confounded with hernia, and no further notice of them is necessary. Nor need anything be said of the so-called diffuse hydrocele of the cord, which is so rare as to be almost chimerical.

Indolent Enlargements of the Testicle, which are probably the consequences of inflammation long gone by, are sometimes mistaken for hernia (28 cases in the Table). The spermatic cord above them is easily defined, and they present no difficulty. So also with strumous testis (of which there are 17 cases), of tumour of the testis (13 cases), and hæmatocele (4 cases). The last resembles hydrocele, but differs from it in consistence, in weight, and sometimes by ecchymosis of the skin over it. All the swellings above enumerated must have been mistaken for irreducible hernia except varicocele and congenital hydrocele. An irreducible hernia always has a thick, firm neck.

Among the other affections less commonly mistaken for hernia were six cases of neuralgia of the testis, four of lax and pendulous scrotum, one of orchitis occurring during mumps, one of perinæal ectopia testis, one of tumour in the scrotum independent of the testis. No case occurs in this list of lipoma of the cord. These circumscribed fatty masses, derived from the subperitoneal fatty tissue, are occasionally reducible, and having nearly the same consistence as omentum, they may simulate it; and when also they have a pedicle of fat extending up to the abdomen, and are irreducible, they are difficult to distinguish from omentum in that condition. They sometimes are found on the surface of a hernial sac, sometimes they project into the interior. They have been described by Pelletan, Cloquet, Macfarlane,[4] Curling, and many others, and have been already referred to at page 58. A case related by Curling,[5] Lawrence, and Brodie was especially difficult of diagnosis, because the tumour was connected above with a thickened cord, and appeared to give rise to the uneasy sensations in the bowels from which the patient suffered. As the size of the mass increased, an operation was at length performed, and the nature of the case established.

The Diagnosis of Labial Swellings in Women.

It was mentioned in Chapter I. that inguinal hernia in women becomes labial in not more than 3.3 per cent. of the cases, and it may here be added that an irreducible labial rupture is a thing almost unknown; and as it has been shown that when a large swelling is mistaken for

hernia, it is generally supposed to be an irreducible hernia, there is not much opportunity in women for making an incorrect diagnosis. Consequently only a few cases of a few diseases are mistaken for labial hernia.

Cysts of the Labium Majus stand first (12 cases), but they offer very little resemblance to inguinal, though sometimes a very exact one to vaginal hernia. The swelling is well defined, is limited above, and gives the sense of fluctuation throughout.

Hydrocele of the Sac.—Together with cysts of the labium may be mentioned those cases in which a hernial sac closes at its upper end and the cavity fills with fluid. A woman came to the Truss Society, when twenty-three years of age, with a left inguinal rupture. She was seen several times afterwards till she was thirty-four. At her last visit no hernia could be detected, but a cyst was present in the upper part of the labium just outside the external ring. No cord could be felt entering the canal. The cyst was said to have existed for a month. During the use of a truss the neck of the hernia appears to have been obliterated, and hydrocele of the sac to have formed.

Hydrocele of the Canal of Nuck, when the abdominal opening of that process has closed, usually occupies the inguinal canal; but it sometimes descends into the labium, and may even reach its posterior extremity. These labial hydroceles, which, according to the observations of Mr. S. Osborn,[6] are not very uncommon, are yet not often mistaken for labial hernia.

Varices of the Labial Veins (6 cases) may attain such proportions as at first sight to suggest hernia; but on the surface some of the dilated veins are always found, which at once declare the nature of the malady. A condition somewhat akin to this was discovered by Cruvelhier in the body of a female brought in for dissection.[7] On each side there was an oblong tumour, which, on account of their consistence and knotty character, he thought to be fatty or omental herniæ. All the veins of the lower extremities were varicose, and the subcutaneous veins of the inguinal regions were conspicuous. On dissection of the left swelling, it was found to consist of tissue like the wall of the uterus between the third and fourth month of pregnancy, and to be traversed by one very large and several moderate-sized varicose veins.

On opening the inguinal canal the veins and the tissue about them were traced into the round ligament, where the veins became continuous with those in the broad ligament of the uterus. The substance of the tumour was composed of the hypertrophied smooth muscle of the round ligament. In the middle of the mass was a small cyst with fibrous walls as large as a filbert. It was packed with particles like spangles as brilliant as mica (? cholesterine). There was cancer of the vagina and bladder which involved the deep veins.

A pendulous tumour of the labium (1 case), as it has no connection with the inguinal canal, will not often raise a doubt. Abscess of the labium (1 case) is accompanied by the signs of inflammation, and, like the cysts, has no cord extending into the abdomen.

Diagnosis of Swellings in the Groin in both Sexes.

The inguinal canal is so easily explored in the male, and hernia in the canal, bubonocele, is so commonly reducible, that there are few instances of mistakes in the diagnosis of this kind of hernia. Retention of the testis in the canal is most likely to lead to error, but this does not often occur, because the absence of the organ in the scrotum at once explains the case.

Nor is there any greater difficulty when fluid distends the tunica vaginalis of a testis so placed. A hydrocele of this last variety has in rare instances passed out of the external ring and mounted upwards on the aponeurosis of the external oblique muscle. Curling[8] described a case of the kind in which the two parts of the sac were separated by a constriction corresponding to the external ring. The testis was ill-developed, and in the canal. There is a resemblance between these cases and interstitial hernia, especially as in the latter the testicle is so often retained in the groin.

When hernia accompanies a testis retained in the canal, the protrusion is sometimes difficult to detect, because hernia in the young, as before observed, may remain reduced for long periods, and nothing that the surgeon can do will bring it down. Little children cannot be made to cough, nor, when they cry, will the rupture always descend. In such cases, either the patient must be seen several times, or the surgeon must accept the statement of the friends that a swelling is wont to appear in addition to that of the testis in the canal.

In one case, instead of a hernia, an effusion of blood in the sheath of the right rectus muscle was found which had followed a recent injury, and in another an exostosis projected from the pubes just below the crest. Iliac abscess may come so far forwards as to present a considerable rounded swelling above Poupart's ligament, and as it has an impulse on cough, may at first sight be misunderstood. The presence of disease of the spine or pelvis, the discovery of the abdominal portion of the swelling, and the sense of fluctuation obtained at all parts of it, suffice to indicate its nature. Before leaving the subject of bubonocele in the male, it may be noted that five cases of pain in the groin, and seven of pain in the loin, were erroneously supposed to be ruptured.

Among the females were two cases of exostosis of the pubes, two of lipoma, one of sarcoma over the inguinal canal, and three of iliac abscess.

Fluid in the canal of Nuck, when the cyst does not pass beyond the external ring, may seem somewhat difficult to distinguish from hernia. Yet it is easy by the sense of fluctuation to ascertain that the swelling contains fluid; and the swelling is irreducible, and an irreducible bubonocele is a thing almost unknown in women.

Enlarged Glands.—A large number of cases of enlarged lymphatic glands is mistaken for hernia in the male, but it is not very certain whether they are supposed to be femoral or incomplete inguinal ruptures. Attention has already been directed to the differences between femoral hernia and enlarged glands. The error is very seldom made in the case of women, though the difficulty of diagnosis in them is much greater than in men. In the Table are 115 male cases, and 22 female.

An error, not infrequent, but far more serious than the last, is made when a hernia is mistaken for an abscess. If the symptoms of inflammation are acute there can be hardly any doubt, but many abscesses in the groin are so indolent, and the skin over them is so little reddened, that they betray the unwary. Many hernia which were supposed to be collections of pus have been incised, and lives have been thus sacrificed to negligence. The records of these cases are met with more often in the surgery of the past than of the present.

Peter de Marchetti relates the case of a peasant having a swelling in the groin for which he consulted a barber, who pronounced it to be a venereal bubo, and recommended incision.[9] The man, as he had been with no other woman but his wife, whose chastity he had no reason to suspect, combated the opinion of the barber. At length the barber prevailed, and incised the tumour. Fæces burst forth, the patient fainted, and the barber stood astonished. Peter de Marchetti was sent for, who wiped the bowel with yolk of egg, returned it to the abdomen, and applied a bandage. The patient recovered, but he appears to have been placed in greater danger by the legitimate than by the illegitimate practitioner. It has generally been strangulated hernia which has been incised for abscess. Heister recommended that the wound in the gut should be closed by suture, and the parts left in the sac, which is a plan of treatment that would probably be followed by many at the present day who might be so unfortunate as to divide the bowel.

Varix of the Saphena Vein, as it affects the female more often than the male, is more frequently mistaken for hernia in women than either enlarged glands or abscess in the groin. The swelling is usually about the size of a pigeon's egg; it is very soft, and does not disappear, but is less in size in the supine posture. A venous thrill is felt in it on cough, whether the patient is standing or lying. If it is reduced when the patient is erect, and pressure is made on the femoral ring and vein, the tumour fills up from below. This can never happen with a hernia, and

distinguishes the disease at once. Between the thigh and the groin there is no enlargement of the veins as a rule, but below the knee varicose veins are generally present.

A case of varix of the saphena vein came under my care some years ago, in which thrombosis of the dilated portion had occurred. A woman, æt. 40, had noticed a lump in the left groin for about a month. There was a swelling in the position of a femoral hernia. The fold of the groin skirted its upper margin. It was the size of a small orange, was movable from side to side, but not from above downwards. The skin over it had a faint brownish yellow tinge. The consistence was firm, elastic, not fluctuating. Varicose veins were seen in both legs, but not in the thighs. The incoming and outgoing veins were ligatured, and the mass removed. It contained compact, partly laminated blood clot.

Psoas Abscess, which was mistaken for hernia in seven men and two women, generally enters the thigh external to the femoral vessels, though I have seen it descend the femoral canal on each side in a case of Pott's disease. It has a distinct impulse on cough, and the skin over it is unchanged. If the abdomen is examined, a swelling is felt above Poupart's ligament, and fluctuation is obtained between the portion in the abdomen and that in the thigh.

Other Affections mistaken for Hernia.—In a man a tumour under the femoral vessels, and pushing them forwards, was taken for a hernia. There are certain rare affections which might be mistaken for femoral hernia. Among these is muscle hernia. They have been described by several writers of note. M. Gaujot saw one in the left thigh of an artilleryman, æt. 19, at the upper and internal part of Scarpa's triangle.[10] The swelling was of six months' duration, and began insidiously. It was indolent, and the skin over it was unaltered. It was the size of a turkey's egg, and seemed to spring from the adductor longus. It did not increase on cough, nor could it be made to disappear on pressure. Its long axis was parallel to Poupart's ligament, and it was placed a little below the fold of the groin. It was limited internally by the border of the adductor, and externally did not reach to the femoral vessels. It had the consistence of muscle. When the limb was adducted, the swelling became more prominent and harder, and little irregular projections, parallel to its long axis, could be felt on the surface.

A memoir on the subject of muscle herniæ was published in 1882 by Dr. Nimier, who has collected several examples like that above described.[11] Those in the adductor longus appear to be usually rather lower down than that in Gaujot's case.

A true hydatid cyst is sometimes found in Scarpa's triangle. In a case under the care of M. Reclus the sac measured 2 inches from above

downwards, and 1½ from side to side.[12] Besides the sense of fluctuation, the cyst, when handled, imparted a sensation like that produced by squeezing starch or snow.

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3. **Curling.**—Op. cit., p. 197.
4. **Macfarlane.**—Med. Chir. Tr., 1830, xvi. 284.
5. **Curling.**—Op. cit., p. 559.
6. **S. Osborn.**—Br. Med. Jour., 1887, ii. 1377.
7. **Cruvelhier.**—Bull. Soc. Anat., 1827, 2nd ed., p. 199.
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9. **P. de Marchetti.**—Quoted by Gladbach, De Her. Crur., Haller's Dis. Chir. Sel., iii., 1755, p. 244.
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CHAPTER XXII.

ON THE SPONTANEOUS CURE OF RUPTURE AND CURE DURING THE USE OF A TRUSS.

Uncertainty as to the Duration of Cure. Since the days of antiquity it has been known that a certain proportion of the ruptured become cured. This happens to some although no treatment whatever is adopted; a larger number are cured during the use of a truss. Malgaigne conjectured that 20 per cent. of the ruptured are cured whilst wearing a truss, and the late Professor Wood puts the number at from 15 to 20 per cent.[1] Such statements must be mere surmise, for it is evident that no man's life is long enough to follow to the end any considerable number of cases. So that though we may under exceptionally favourable circumstances watch the continuance of a cure for some years, how few can assure themselves that that cure is permanent. Hence, partly because patients pass out of view, partly because professional life is so brief, our observations on the result of the cure of hernia, whether by truss or operation, are vague and unsatisfactory.

In a previous chapter have been pointed out the anatomical appearances which present themselves when a hernia has ceased to descend. The obliteration of the neck of the sac, or the closure of its mouth by adherent omentum, are the most obvious pathological signs of cure. In some cases the sac remains patent throughout, but the mouth and neck have become very narrow.

In the present chapter such clinical facts will be considered as have some bearing upon the cure of hernia when it occurs spontaneously, and when it follows the use of a truss.

Means of Ascertaining the Duration of Cure.—Persons who are themselves ruptured occasionally give information concerning a relative who has been cured of hernia, but this hearsay evidence cannot be brought into use. There are two ways by which we may learn something of the duration of the cure of hernia; firstly, from patients who are cured of one rupture and become affected on the opposite side, whilst the original side remains sound; secondly, from those who have been cured for a term of years. A patient neglects his truss, or purposely discards it, and thus discovers that he is cured. The exact period, therefore, which was required to effect this, is not known, and in many cases the truss is probably worn long after cure has taken place. When a surgeon is consulted by a patient, who wishes to know if he is cured, it is not safe to assume, after submitting him to the usual tests, and finding no protrusion, that a cure has resulted; for when a truss has been worn for any length of time, the rupture in very many cases gives no sign. If the truss is left off, the rupture usually declares itself again soon afterwards, so that it is not prudent for the surgeon to recommend its disuse. In early life many cases undergo a temporary cure of two or three years, but in these the respite is so short that no further reference to them need be made.

Persons are met with occasionally who have a recent rupture on one side, but who formerly were affected on the opposite side where no vestige of a hernia remains. The long standing records of the Truss Society enable us to trace back some of these, and to verify the primary protrusion; in other cases we are indebted to the second rupture for our knowledge of the first. Among thirty-four of the Society's male patients, four were cured spontaneously, and thirty after the use of a truss, whilst an average period of 19.9 years intervened between the cure of the first rupture and the appearance of the second. No return of the original hernia was noticed while the patients were under observation.

Temporary Cures.—But a much larger number of persons are cured for a time, and at length the viscera descend again on the same side. Among 240 males who became exempt from rupture for longer or shorter

periods,* 37 were cured spontaneously, and 203 after wearing a truss. The number of years during which the hernia ceased to come down was on an average, in both sets of cases, 22.5 years.† The longest period of exemption was sixty-two years. Only two cases of femoral hernia were cured, the 240, just mentioned, being all inguinal.

Age most favourable for Cure.—The ages of the patients when the hernia first appeared are given in the following Table, in which the spontaneous and truss cures are added together.

TABLE XXIV.

Cases of Inguinal Hernia in Males, in whom Cure took place for a Term of Years, entered according to the Age of the Patient when the Rupture first appeared.

Total.	Under 1	1–5	6–10	11–15	16–20	21–25	26–30	31–35	36–40	45–50
240	140	23	18	12	17	12	12	1	3	2

It is here seen that after thirty years of age even these temporary cures are very rare, and that the majority occur in those who are ruptured during the first year of life (= 58 per cent.). The infrequency of cure after thirty has long been recognised by the profession, and Freytag early in the last century laid particular stress upon it.[2] The herniæ subsequent to that age seldom occupy an unobliterated portion of the processus vaginalis, which has a natural tendency to close, nor have the tissues then the same resiliency as in youth. The considerable number of cures in early life is also perhaps due in part to the peculiarity, so often referred to, which consists in the rupture remaining reduced sometimes for days or weeks in children. But for this it would be difficult to understand the spontaneous cures in infants.

Cure among Females.—Among females, the instances of recovery, either temporary or permanent, are much fewer than in males, but we have no means of ascertaining the relative frequency of the event in the two sexes. It is very probable that cure is more frequent among females, and though direct evidence of this is wanting, it may be because the cures in them are more often permanent. It is only by accident that we become acquainted with cures of long duration, for patients will

* In no case for less than four years.

† M. Segond gives a Table of 39 cases, which relapsed after cure, in his essay (Cure Rad. des Her., 1883, p. 356, Table H.), from the unpublished statistics of M. Paul Berger. The average period of exemption of 38 cases was twenty-four years.

not come merely to declare themselves still free. That a number of female cases recover is all the more likely from the following considerations. Inguinal hernia in women is not such a serious disease as in men, and of all ruptures it is the least liable to strangulation. Moreover, there is a much smaller proportion of labial in females than of scrotal cases in males, which is an indication that it has less tendency to assume a severe form in the former; and all the causes which render inguinal hernia less frequent tell also in favour of its more frequent cure in women. Lastly, the easy and sedentary nature of their occupations aids the disappearance of these protrusions.

Incurability of Femoral Hernia.—But the case is quite otherwise with femoral hernia, which so seldom recedes in either sex that it must be deemed incurable. It is well known from pathological observations that these herniæ become obliterated, but the instances are so few that they give no ground for hope of a favourable issue in general.

Time during which the Truss is Worn.—It remains to be said that where a cure, temporary or permanent, has resulted from wearing a truss, the instrument has been used on an average between five and six years.

The Probability of Cure.—The question is often asked—is asked, indeed, by every mother of a ruptured child—"Will he get well?" No answer can be given as regards the individual case. We can only speak of probabilities. It may be said that many boys are cured, and that the prospect is more favourable still in girls; that the younger the patient, the more probable the cure; that with femoral hernia there is little chance of ever being able to dispense with a truss, and that, after thirty years of age, cure is not to be expected in either sex, or in either kind of hernia. Cure does not come about, as a rule, unless the truss is worn night and day. I cannot take upon myself to advise a patient to leave off a truss even when all visible trace of his hernia has disappeared, because, though many are free perhaps for the remainder of their lives, many others are free only for a certain period, which, though it may reach the average of twenty-two years, is often very much less. There is no sign in the individual case by which one can predict a permanent or a temporary cure. The patient therefore should take upon himself the responsibility if he lays aside his truss.

Cure in the Recumbent Posture.—Before leaving this subject it may be well to refer to those cases where a hernia is cured by keeping the recumbent posture. Instances of this are to be met with in the works of Wiseman, Rossetus, Scholler, Sharpe, and most of the great writers. The patient either meets with an accident or contracts an illness, which obliges him to keep his bed, and, on getting up, he finds that his rupture is cured. In most of the cases that have come under my observation the hernia has returned in three or four years. It very rarely happens

that a patient lies down voluntarily for the purpose of healing his rupture. A young man who was much engaged in athletic exercises became ruptured on the right side at the age of twenty-three. Finding that it debarred him from his favourite pursuit, he resolved to lie down, and remained in the house, either in bed or on the sofa, for five months. He then found that the hernia had disappeared, and resumed his exercises with full vigour. He enjoyed complete immunity for three years. At the age of thirty-four his hernia was scrotal.

Cure during Pregnancy.—In women hernia is sometimes cured during pregnancy, or by the rest in bed after delivery. A girl had a left inguinal protrusion at the age of sixteen. A truss was procured, which she did not wear. She married at twenty years of age, and soon became pregnant. The hernia then disappeared, and did not again descend till she was twenty-seven, during the seventh month of her fourth pregnancy. The rupture was reduced with difficulty. She had no protrusion after that up to the time of her last visit at the age of thirty-four.

The mother of a medical man noticed a femoral hernia, at the age of thirty, during her third pregnancy. The child was ruptured, and wore a truss for some years. The mother's rupture disappeared during the next pregnancy, and never recurred. Nine children were born after the cure; she died at the age of seventy-five, and was under professional observation till her death.

Alternating Cure and Relapse. Those rare cases may here be mentioned in which a cure and relapse occur more than once in the same person, and those in which the hernia alternates from side to side.

The best instance of this last anomaly, with which I am acquainted, is the case of a patient whose history was partly described by Mr. Kingdon at page 318 of his essay in the Med. Chir. Transactions. The observations made since then enable me to give the case in full. The man was ruptured at the age of nine on the left side, but did not wear a truss. At the age of fifty he was thrown from his horse on his head, and when he recovered from the accident, the hernia had disappeared. At the age of sixty-two, during an attack of bronchitis, a hernia entered the right scrotum. There was no protrusion on the left. At the age of sixty-four his condition was unchanged. When he was just eighty years old, the hernia again descended on the left side into the scrotum, whilst the right hernia disappeared.

The Ash Cure. Before closing this chapter, I may refer to a quaint superstitious rite which has been practised for many centuries by the country people in England and on the Continent for the purpose of curing ruptures. It has been mentioned by several writers, but is best described in the words of Gilbert White, who says,[3] "In a farmyard, near the middle of this village (of Selborne), stands at this day a row of

pollard ashes, which, by the seams and long cicatrices down their sides, manifestly show that in former times they have been cleft asunder. These trees, when young and flexible, were severed, and held open by wedges, while ruptured children, stripped naked, were pushed through the apertures, under a persuasion that by such a process the poor babes would be cured of their infirmity. As soon as the operation was over, the tree in the suffering part was plastered with loam, and carefully swathed up. If the parts coalesced and soldered together, as usually fell out, where the feat was performed with any adroitness at all, the party was cured; but where the cleft continued to gape, the operation, it was supposed, would prove ineffectual." This custom is of remote origin, and Gilbert White supposed that it came down to us from our Saxon ancestors. In this country it was still practised in the first half of the present century. Mr. Kingdon has kindly furnished me with a short list of cases, patients of the Truss Society, who had been "cured" in infancy after being passed through a split ash-tree, and had since relapsed.* In 1889, a man, æt. 73, visited the Institution, whose hernia had not been improved by the cure which he had undergone in 1827.

It is very probable, however, that cure sometimes followed after the ceremony, owing no doubt to that peculiarity of children's ruptures whereby they may remain reduced for a length of time, and hence afford an opportunity for the inguinal canal to close. The spontaneous cures thus resulting have upheld the credit of the superstition, and served to keep it so long alive.

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* The subject is mentioned by Evelyn, and is described at some length in Hone's Table Book, vol. ii., 1828, p. 466. Mr. Kingdon has favoured me with the following references to this curious custom—A Provincial Glossary, with a Collection of Local Proverbs and Popular Superstitions, by Francis Grose, Esq., F.A.S., 2nd edit., London, 1790, p. 42 of last part; Popular Romances of the West of England, or the Drolls, Traditions, and Superstitions of Old Cornwall, by Rob. Hunt, F.R.S., 3rd edit., London, 1881, p. 421.

CHAPTER XXIII.

THE REDUCTION OF HERNIA.

The first step in the treatment of hernia is to replace the protruded parts. Various methods have been devised for effecting this, of which the most successful is that of making pressure on the rupture itself.

Reduction by Cold Affusion.—One plan, which was in vogue up to the beginning of this century, was to throw cold water over the naked part. It is mentioned by Dionis, and again, with some favour, by Hey, who had employed it occasionally with success. Petit relates a case of a young man whose hernia he had failed to reduce, and upon whom he was preparing to operate. Before his arrangements were completed, the grandmother of the patient came into the room, and, after laying the man on the floor with his thighs apart, dashed a pail of cold water over the scrotum. The hernia immediately went back.[1] No principle underlies this proceeding, and it has long been abandoned for measures more certain, and perhaps less disagreeable.

By Inversion.—Among the older methods was one by which it was attempted to make traction on the protruded parts from within the cavity of the belly.*[2] This was done by inverting the patient so that the viscera might fall away from the iliac fossæ, and tend by their weight to drag the protruded portion into the abdomen. Shacher actually recommended in cases of difficulty hiring four soldiers to seize the patient and turn him on his head.[3] Sir Astley Cooper, who had seen inversion practised, says that where other methods had failed, he had not known it to succeed. The effect of reversing the position of the body is twofold; firstly, the weight of the viscera tend to pull the protruded parts out of the ring; and, secondly, the intra-abdominal pressure is reduced. At the present day, instead of inverting the patient, some obtain the same effect by placing him on his knees and elbows, or on his knees and shoulders. Schatz has shown that in the knee-elbow position the intra-abdominal pressure falls to minus 2 cubic centimetres of water, and in the knee-shoulder position it falls to minus 6 cubic centimetres of water.[4] †

By dragging the Intestine from the Abdominal Side.—Various other ways have been suggested for drawing upon the intestine from

* Guido de Chauliac mentions suspension by the feet and ankles as a means of reduction.

† The knee-elbow position was recommended by Winslow, according to Malgaigne. (Man. of Op. Surg., tr. 1846, 422.)

above the ring. Some have applied weights above Poupart's ligament on the parts entering the hernia.* Others have endeavoured to drag the intestine out of the ring by making pressure with the hands above Poupart's ligament upwards and backwards. All these methods have been combined with simultaneous pressure on the rupture itself. If the cause of irreducibility is the impaction of the wedge of mesentery belonging to the protruded bowel, a pull from within ought to disengage it and facilitate reduction. This method has been advocated by Sédillot, Lossen, Kocher, Panthel, and others.[5] Again, it has been attempted to withdraw the bowel by a pull exercised from the rectum (Popp, Simon), and Malgeri has even recommended the distension of the bowel below the stricture with carbonic acid gas by means of an effervescing enema, whereby the necessary traction might be obtained.[6]

By Taxis.—The principal means of reduction is the taxis, that is, the application of pressure to the rupture by the surgeon's hand. Many seek to aid this manœuvre by placing the patient in such a position that the openings by which the hernia comes may be relaxed as much as possible, and that the viscera may tend to fall away from the rings. The patient's buttocks and shoulders are raised, and the thighs flexed and brought near together. The raising of the buttocks, if it does no good, can do no harm; but the flexing of the thigh, whereby the openings in the abdominal muscles are relaxed, I regard as not only useless, but also as a positive impediment. If the rings are not resistant, they recede before the pressure, and part of the force is thus expended. Arnaud was aware of the tendency of the rings to yield before the efforts of the surgeon, and of the effect of this in hindering reduction. He is one of the few who have recognised the practical importance of keeping the parts as tense as possible during taxis.

After the invention of the operation for strangulation, we find this instruction repeated by one writer after another, that the part which came down last must be replaced first. Nicolas Lequin added a very important observation when he said: "I have always seen that that which is found below (the patient being supine) and nearest to the os pubis, is that which is reduced first, and consequently which comes out last."[7] Dionis, a little later, says that we should begin with the intestine, which, being situated under the omentum, ought to be replaced first.[8]

Herein lies the chief secret of successful taxis. The parts in the sac which first descended are in front; those which came after were added from behind. Every endeavour, therefore, must be made to start the contents at the back of the sac towards the abdomen, when the rest will soon follow. Whether the case is inguinal or femoral, the surgeon

* Desprès says that H. Earle used a bladder of quicksilver for this purpose. Lannelogue used a leaden weight. (Bull. Soc. Chir., 1871, p. 75.)

should direct his pressure so as to cause upward movement of the viscera at the back of the hernia. Subject to this condition, the pressure must always be made in the direction of the axis of the neck of the sac.

Surgeons may differ in their manner of putting into practice the principle above enunciated. I will here describe the manipulations which have been found the most successful when reduction was possible.

Taxis: *The First Position.*—In all cases the patient is placed on a low couch, flat upon his back, and with his legs straight, and the surgeon stands by his side, facing the feet. In inguinal hernia, when the protrusion is of moderate size, so that it is easily grasped, one hand should be used to steady the upper part of the sac, near the external ring, the thumb on one side and the fingers on the other. The disengaged hand should be placed so that the fundus of the sac is in the hollow of the palm, the thumb on the front, and the fingers at the back of the sac. The hand at the neck of the sac has three functions. It causes the entry of the sac to form a sort of funnel instead of a mere aperture; it opposes the reprotrusion of parts already reduced; and it prevents the sac or the contents from overlapping the external ring.

On the pubic side of the neck of the sac the contents cannot overlap the edge of the opening, but in front they may do so, and this very much increases the difficulty of reduction. The lower hand is not to press the rupture directly upwards and outwards against the external ring. The thumb should rather be used to draw down the front of the sac whilst the fingers make pressure upwards at the back. This lower hand, in fact, begins a movement which, if completed, would be a sort of rotation of the contents of the rupture, a movement which would cause the viscera in front to slide down the anterior wall of the sac to the fundus, and thence ascend to the mouth along the posterior wall. During taxis the sac should be kept as nearly as possible in a line with the oblique direction of the neck.

The Second Position.—If the resistance is great, the hands must be changed to a position in which they can exercise more force. The fingers of both hands should be placed behind the hernia, and the two thumbs on its front surface directed towards the surgeon. The fundus of the tumour is in the palms of the hands, which are towards the surgeon, who is at the side of the body with his back to the patient's face. The pressure should be directed towards the back of the sac in this case and in all cases.

The Third Position.—When a scrotal rupture is large, one hand cannot be spared to steady the neck, but both must be used to exert pressure. They should be placed one on each side of the rupture with the thumbs in front, and the fingers at the back of the sac pointing away from the surgeon. The wrists should press against the upper end of the sac and

prevent the parts overlapping the external ring. The sac, whilst pressure is made upon it, should be drawn somewhat away from the pubes instead of being pushed up towards it.* This has the effect of straightening out the neck, and facilitates reduction.

The Bowel returns first.—Upward movement of the contents is always first felt at the back of the sac where the bowel is situated. After the gut, which is seldom irreducible, has begun to enter the belly, the omentum usually follows easily, but sometimes it is very difficult to return, even though no adhesions exist.

Difficulty in returning the Omentum.—During taxis the omentum is often in part crowded into the canal, forms a hard mass there, and will not pass the inner ring. Before giving up the attempt, take hold of the omentum through the sac wall, draw down again as much of it as possible, and begin reduction afresh. This practice is frequently successful.

It has been recommended to move the sac from side to side in these cases, or shake it, as Gladbach said.[9] This is the so-called zigzag movement.† I have not found it of much value. With a large scrotal rupture it is sometimes advantageous to lift up the sac till its axis is nearly vertical. A displacement of the contents seems to be thus effected, which is occasionally followed by reduction.

Reduction of Femoral Hernia.—Femoral hernia is more difficult to reduce than inguinal, not only because the parts protrude through a narrow opening, but also because the surgeon cannot grasp the tumour with the same facility. When a femoral hernia is about to be returned, it should be remembered that the sac on reaching the thigh turns forwards, so that its axis is nearly at right angles to that of its neck. Therefore the sac must be pushed downwards so as to bring the axis of the neck and of the sac into one and the same straight line. The best mode of holding the rupture is that described as the second position for inguinal, with the thumbs close together on the front of the sac and the fingers behind it, directed towards the surgeon. The thumbs draw down the sac in front at the same time that they assist to make the pressure. With large femoral herniæ the other methods, above described, may be tried.

Some surgeons prefer to compress the rupture from side to side, that is, at right angles to the axis of the tumour, the "compressions taxis" of the Germans, and this method was favoured by no less distinguished a person than Amussat.[10] In cases free from difficulty I have found this method perfectly successful, but very much inferior to those above recommended, when great resistance has to be overcome. It is evident

* This carrying of the sac away from the body was suggested by Richter.

† This movement has been strongly advocated of late years by some of the German surgeons.

that Amussat's plan does not enable us to put in practice very effectually the principle which I have endeavoured to explain.

Taxis when the Hernia is not Strangulated.—So far as the mode of conducting taxis is concerned, it is the same whether the rupture is strangulated or non-strangulated, but in other respects the rules are different. The following observations are intended to apply only to cases which are not strangulated, except where otherwise specified, as the application of these rules to strangulated hernia might lead to the most serious consequences.

The Amount of Force to be used.—How much force is it safe to employ when using taxis? As a rule, all the force that the surgeon can put into his hands, assisted by the weight of the shoulders. But, in saying this, I take for granted that the pressure is made in the right direction. The pressure should be moderate at first, and be gradually increased. In very old persons, whose tissues are friable, we must be cautious in employing our whole strength. The ruptures of young children hardly ever give trouble in reduction, and need little pressure.

The Duration of Taxis.—How long should taxis be continued? If the rupture does not return in five minutes, the chances are very slight that it will return at all. But I am supposing still that taxis has been applied after the most favourable plan. Amussat recommended the employment of taxis in strangulated hernia for a period extending over several hours, and this practice has frequently been adopted by other French surgeons. The method was called at Glasgow, according to M'Leod, "the two-horse power mode of curing strangulated hernia."[11] It is unnecessary to point out the evils of such a proceeding in this country, where gentler means prevail.

Signs that the Hernia is going back. There are two signs which indicate the probable result of the taxis. Firstly, if the parts within the sac are felt to move on one another they often go back, and the pressure may be continued a little longer under these circumstances. Secondly, if the patient evinces signs of pain, the hernia generally returns. If the patient lies still, and is indifferent to the proceedings, there is so little hope of success that it is idle to continue the attempt. When a rupture is going back the pain is almost always acute, and is most severe at the moment of reduction. During taxis a patient sometimes turns ashy pale, and large beads of sweat come out upon his forehead, whilst in rare cases vomiting occurs.

Pain after Reduction.—If a large hernia has been long down, the patient suffers considerable distress, often amounting to pain, after the parts are put back. This is especially noticeable in young children with large ruptures, who begin to cry after the bowels have been returned, but the same pain is frequently observed in the adult. The abdomen

has accommodated itself to the size of the viscera which have not been protruded, and resents the introduction of a quantity for which it has no longer room. To use Petit's celebrated phrase, the viscera have "lost their right of domicile."* The pain under these circumstances is sometimes so great that it is necessary to let the parts come down again.

Several surgeons have noticed the serious consequences which may attend the reduction of large ruptures, among them Arnaud, Petit, Sandifort,[12] Howship, and others. Zimmer, in speaking of the reduction of "vast ruptures," says that they cannot be put back without great danger to life, because the reduction causes such a disturbance of the lower belly as to cause a fatal syncope.[13]

Professor Küster, in recent years, has had a case in which, after reduction of a large hernia during operation, the contents of the stomach entered the air passages, and death from suffocation ensued.[14] The professor explains the occurrence by supposing that the stomach was compressed when the viscera had been forced into the abdomen, which had become too much contracted to receive them.

In cases where the resistance to the return of the viscera has been great, whether the rupture be large or small, the patient has sometimes pain in the belly which lasts for two or three days afterwards. It is occasionally alarming, and gives rise to the suspicion that serious damage has been done, but it soon moderates, and in a few days passes off altogether.

Difficulty of Reduction caused by Omentum or Mesentery.—It is not the bowel which occasions the difficulties of taxis. Where the opposition to the return of the parts is great, it is almost always caused by the omentum, but occasionally a large quantity of mesentery descends, and then the difficulty of reduction is extreme.

The Injuries to the Sac or to the viscera which may be caused by taxis occur almost invariably during strangulation, and will be described in the chapter devoted to that subject.

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CHAPTER XXIV.

ON THE CONSTRUCTION AND APPLICATION OF TRUSSES.

PART I.

ON THE CONSTRUCTION OF TRUSSES.

Old Method of Retaining a Rupture.—After the contents of a rupture have been reduced, mechanical means must be used to keep them reduced. The simplest, and probably the oldest, device for this purpose was a girdle, made of some firm material, worn around the pelvis and fastened to a pad which compressed the inguinal region (Celsus). This appears to have been commonly employed in one form or another for many centuries, and, though it was discredited by the invention of the spring truss, and ultimately discarded by all surgeons of repute, it has survived up to our own time in the hands of some of the truss-makers. The well-known "Mocmain" truss is essentially of this description.*

Defects of the Non-Elastic Truss.—A non-elastic instrument possesses this fatal defect, that it cannot press equally in all positions of the body, and, according to the different states of the abdomen, will be at

* This truss, like so many of the patent trusses, is an unacknowledged revival of an old invention. It was designed by Camper, and made for him by a saddler at Amsterdam.[1] Camper says that he afterwards heard that it was of much older date, and had been made elsewhere. He soon discovered its defects, and abandoned it for the spring truss, which he did so much to improve. The present "Mocmain" appears to differ from Camper's truss only in the material composing the pad.

one time too tight, and at another too loose. It is obvious, also, that it does not admit of the same nicety of adjustment as the elastic truss. These objections have been deemed so serious that the non-elastic truss cannot be used by any surgeon who regards his patient's welfare or his own credit.

The Bag Truss.—Another old-fashioned bandage, which comes under the same condemnation, is the so-called "bag truss." It was intended for scrotal ruptures, and contained the parts in a bag of leather or other substance, which was generally laced up the front. Jalade Lafonde tells us that by an ordinance of Philip de Valois, which was confirmed by each sovereign down to Charles IX., the manufacture of trusses in France was entrusted to the guild of purse-makers. It is no doubt to this fraternity that we owe the bag truss.

The Iron Truss.—A truss of iron was first recommended in 1306 by Gordon,[2] and, according to Marc Gatinaria,[3] trusses, whose shield (pad) and circle were of iron, were constructed in Italy at the end of the fifteenth century by a locksmith of Pavia.

The Steel Truss.—It was not till 1665 that Nicolas Lequin published the description of his steel truss which he had used since 1628.[4] The book of this estimable person was printed for the author and sold by himself in Paris, at his house in the Rue St. Germain, at the sign of the Golden Truss.* In the preface he says, very justly, that he had borrowed nothing, either of the ancients or moderns, for there had not been any one of them who had written of steel trusses. Lequin possessed a comprehensive and very practical knowledge of that which he professed to teach, and among those who followed him, no one has shown the same mastery of the subject until the time of Camper and Sir Astley Cooper. The observations of the latter on the application of trusses, and those of Camper on the fabrication of trusses, are especially valuable, and it is from these three surgeons that we derive the principles of their construction and of their use. Towards the end of the seventeenth century Blegny brought out a steel truss. This man, according to the history of him given by Dionis, began life in the medical school of St. Cosme as a kind of dissecting-room porter.[5] Eventually he obtained a degree in medicine, and became notorious for his bitterness in controversy, and for other singularities not more creditable. He contested the priority of the invention of the spring truss with Antony Le Quin, the nephew of Nicolas.

* It is probable that the shops of truss-makers were commonly distinguished in olden times by the sign of a Golden Truss, for De Launay, in 1690, after enumerating on his title-page the various conveniences to be purchased in his shop, says that it is near the Pont Neuf, at the sign of the Golden Truss. (Instructions necessaires pour ceux qui sont incommodes des de'centes. Paris, 12mo, 1690.)

Its Introduction into England. — It is probable that steel trusses were not introduced into England till 1733, for Sheldrake says, that in the trial of Brand *v.* Reid it was proved that elastic trusses were first made in England by Blakey, who acknowledged that he brought the invention from Paris.[6] In a pamphlet published in 1764, Blakey said that he made the invention public in 1733. Many trusses in the last century which were called "steel" appear to have been made of iron.[7]

Parts of a Truss.—A truss consists of two principal parts—the pad, which covers the hernial opening; and the spring, which imparts to the pad its power of resisting the escape of the viscera.

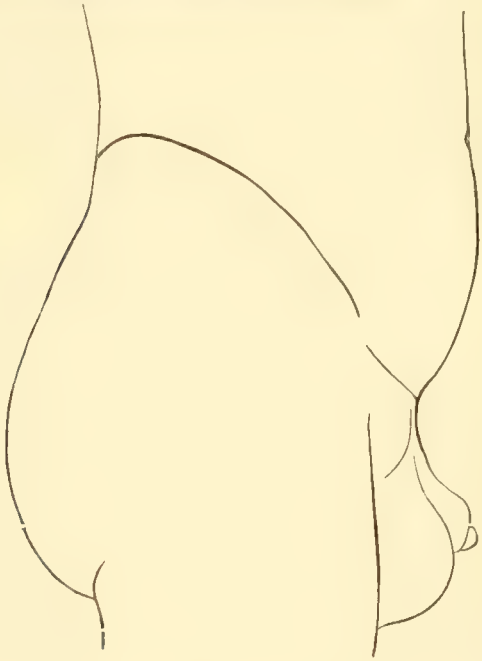


FIG. 12.—Outline of an adult male, side view, to show the oblique direction of the iliac crest.

Position of the Spring.—It is evident that if the pad is to keep its position unmoved, the spring, which embraces the pelvis to a greater or less extent, must rest against parts not liable to movement. Just below the crest of the ilium and across the base of the sacrum there is, as a rule, only a thin layer of soft tissue over the bone, so that if the spring follows the line of the iliac crest it is less subject to disturbance than if it were lower, where the muscles are thick, or higher, where there is no underlying bone. The oblique line in Fig. 12 runs just below the iliac crest, and marks the most desirable course for the spring of the truss.

Length of the Spring.—Another question, which concerns the stability of the pad, is, how far round the pelvis should the spring extend? The further the spring reaches, the steadier the truss. Lequin made his metal-work surround two-thirds of the pelvis; Camper increased this to five-sixths, and demonstrated the necessity for it.[8] Many have preferred a much shorter spring than Camper's, and the old "semicircular" spring, which terminated at the middle line behind, has enjoyed great popularity, and is often sold at the present time by truss-makers under various guises.

The Semicircular Spring.—If the spring ends over the sacrum, a strap

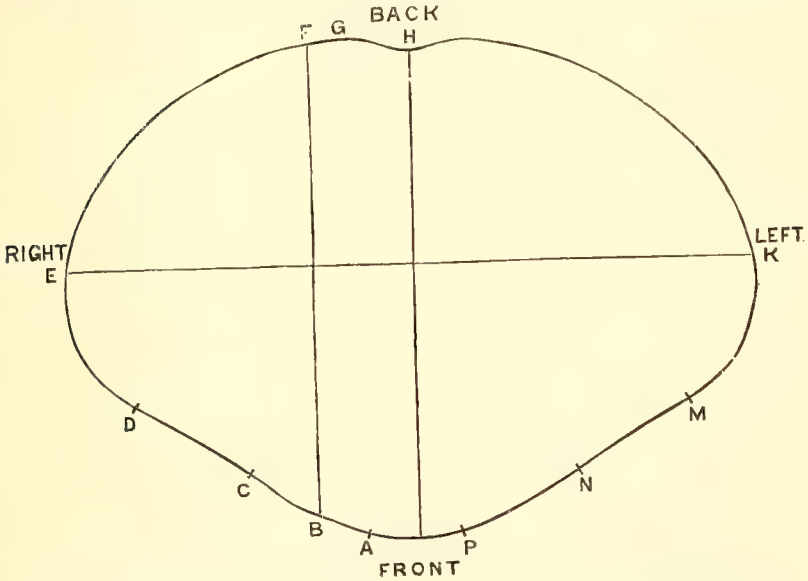


FIG. 13.—Reduced outline of an adult male pelvis taken with the cyrtometer, just below the iliac crests. A and P = the outer edge of rectus. C and N = the internal inguinal ring. D and M = the anterior superior iliac spines.

fastened to it must be carried round the pelvis on the sound side to the pad in front. If no such strap is provided, the pad is so insecure, as Camper pointed out, that it is quite unjustifiable to use a truss of this kind. The outline in Fig. 13, which was taken with the Cyrtometer, shows the shape of the pelvis in an adult male of normal type, when the tracing is made just below the iliac crest and through the base of the sacrum. In front the line terminates a little above the symphysis pubis.

If the truss extends only from B to H, Fig. 13, in which A to C marks the site of the inguinal canal, it is seen at a glance that it has no hold on the pelvis, and that its tendency is to slip off. If the truss is

kept on by the strap above-mentioned, it is subject to the following disadvantages. 1. The pressure of the pad, instead of being wholly derived from the spring, is partly dependent on the strap. 2. The strap stretches, and thus permits displacement of the pad. 3. The strap causes discomfort.

Distribution of Counter Pressure. The spring of a truss when it makes pressure must have a point of counter pressure, and in the distribution of the counter pressure the truss with a short spring compares very unfavourably with that having a long one. As the counter pressure in the former is limited to a small area, it is more irksome than when it is extended over a longer surface. Lequin directs that the spring, after passing the middle line of the back, should be made to diminish little by little to its end. It is found that if the truss is thus made to taper towards its extremity, the stability is not materially lessened, while the counter pressure is distributed with insensible gradations, and the comfort of the instrument is greatly increased. Few truss-makers, however, at the present day go to the expense of forging the end of the spring. Mr. Pebardy tells me that the tapering is effected by first cutting the strip of steel from the sheet with one end narrower than the other, and secondly, by hammering the narrow end whilst hot. The result of this forging is to lessen the thickness of the steel, which does not, as might be imagined, widen to any material extent under the blows of the hammer, but only lengthens.*

Camper's Spring. Camper's spring ends on the sound side just behind the anterior superior iliac spine. Whatever additional security is obtained by carrying the end of the spring still further forwards is counterbalanced by the inconvenience which this causes in applying the instrument.

Shape of the Spring. The stability of the pad is dependent not only on the length, but also on the shape of the spring. The shape of the spring is so intimately connected with the force which it exerts, that it is hardly possible to keep the two subjects completely separate, and they will be here considered together.

The Ideal Truss.—If it were in the power of man to construct a perfect truss, it would possess two chief characteristics; it would make no pressure at the hernial opening during periods of quiet, but would offer during expulsive efforts an insurmountable resistance to the outcoming parts. Among the several obstacles to the production of such an instrument is this, that in the same person the size of the parts embraced by the truss is not constant, but varies with the state of distension

* The spring widens a little under the hammer, but increases chiefly in length. This, however, can only be achieved by a dexterous workman, and requires much practice and skill.

of the abdomen ; and that with these changes the pressure of the instrument varies. Hence it is that the different machines which have been invented for measuring the power of a truss are of so little service, because the pressure to be overcome is a varying quantity. In like manner, a truss of a given length will not exert the same pressure in a person with a shallow pelvis as in one with a pelvis which is wide from before backwards. In constructing trusses there is no satisfactory method of making a correction for the changes in the size of the parts encircled. There are, however, several devices in use which have been designed to overcome this difficulty, such as placing in the pad a coil of spring wire, &c., but they have the effect of lessening the stability of the pad, which is a fault that precludes their employment.

Two kinds of Trusses with Long Spring.—The trusses which have a spring of full length may be divided into two classes ; (1) those which have the spring very much curved or curled ; and (2) those which have an open curve, and a shape nearly approaching to that of the body.

Trusses of the First Class, though they may have a light spring, yet are so much unfolded when applied to the patient that they keep up a constant and strong pressure. This is exceedingly uncomfortable ; in the majority of cases it is not necessary, and it may do harm by causing absorption of the tissues of the abdominal wall. The French spring truss is of this description, as also is that used in Italy and Belgium. These sharply curved instruments make no pretence of conforming to the ideal truss above described. They are frequently effectual in retaining the rupture, which is a principal consideration ; but they do something more which is not to the advantage of the patient.

In the Second Class of Truss, the spring has an open curve, and a shape nearly the same as the outline of the body, so that, when applied, it makes very light pressure on the hernial opening. If the spring is made strong, the truss offers great resistance to the protrusion of the viscera, though it sits lightly whilst the abdominal muscles are quiet. A truss made on this principle approaches more nearly than any other to the ideal instrument, and for that reason should be preferred to any other.

Trusses made in series of different Lengths.—Some surgeons recommend that, in order to ensure accuracy in fitting, a truss should be made for each individual patient. Such a proceeding would greatly increase the cost of production, and could hardly be carried out by a truss-maker in large practice. Nor is it at all necessary, for in persons of the same girth the outline of the pelvis varies very little. If the truss is formed on the model of the most common type of pelvis, it will fit the generality of persons of the same size, and the slight modifications sometimes needed can be generally made in it without constructing a special

instrument. Thus a whole series of trusses can be manufactured beginning from 11 inches in length and increasing inch by inch up to 40 inches or beyond.

As a rule, the larger the girth of the patient, the more forcible is the impact of the viscera; consequently, the longer the truss, the greater must be the strength of the spring. The amount of power to be given to springs of different lengths can only be determined by an extended course of observations on ruptured persons. The power depends upon the width and thickness of the piece of steel, and for each length of spring the thickness of the metal has been accurately gauged.

Variation in the Outline of the Pelvis at different Ages.—The outline of that part of the pelvis which is surrounded by the truss was described by Camper and others as an ellipse, but the true form does not possess a figure quite so regular. In a well-shaped adult male the

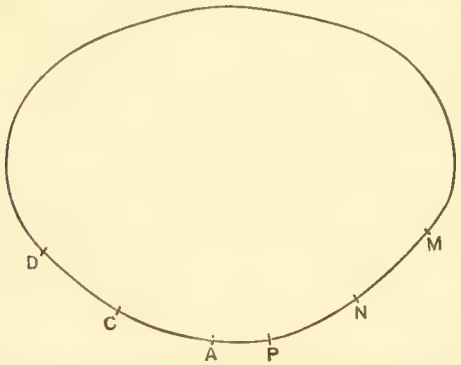


FIG. 14 shows the reduced outline of the pelvis of a boy, æt. 8, taken in the same way as Fig. 13. The letters refer to the same parts as in Fig. 13.

outline of the pelvis at the part indicated is represented in Fig. 13. At the back there is a slight hollow, which marks the position of the sacrum between the prominent ilia; and in front, just internal to the anterior superior iliac spine, there is a slight recession.

In younger, that is, in smaller figures, the outline is more nearly elliptical, as in Fig. 14; and in larger, that is, as a rule, in older persons, there is often a tendency for the outline to become circular (Fig. 15).

Deviations from the Normal Type.—The two most common deviations from the normal type, and, indeed, I may say, the only two which give rise to any difficulty in practice, are (1) the last-mentioned, which is usually met with in persons past the meridian of life; and (2) that in which the length from before backwards (in the line B F, Fig. 13) is much shorter than the normal.

There are two spots at which the truss is most liable to chafe the

patient; and therefore, I suppose, it is at these places that the maker has most difficulty in fashioning the spring. The first is at the back, where the instrument crosses the posterior edges of the ilia (Fig. 13, G); the second is at, what is called, the shoulder of the truss, where it turns round the anterior superior iliac spine to reach the front of the belly. With a shallow pelvis the truss is so apt to rub at the curve of the shoulder that it is often necessary to direct the maker to give it a sharp turn at this spot.

Shaping of the Spring.—The instrument cannot be made to fit by

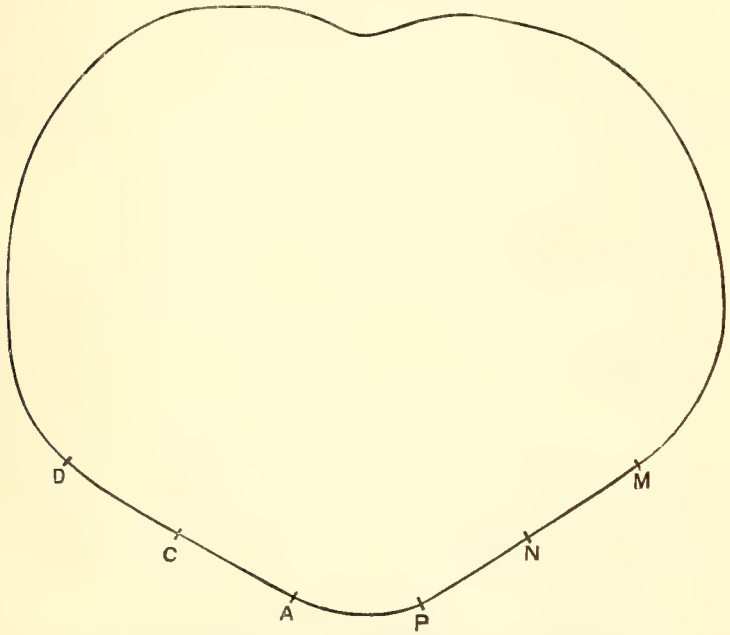


FIG. 15 shows the reduced outline of the pelvis of a male, æt. 65, taken in the same way as Figs. 13 and 14. The letters refer to the same parts as in Figs. 13 and 14.

merely attending to its outline. If the body is viewed in profile (Fig. 12), it will be seen that across the loins the slope is such that the lower border of the truss must be made to slant, or the spring will rest against the patient, not with its surface, but with its edge. In order to effect this lengthening or setting out of the lower margin of the spring, the following device is employed. The straight and flat strip of steel, out of which the spring is fashioned, is worked into a shape slightly curved on the flat, "scimitared" in the technical phrase, so that one edge is made longer than the other. If the steel is of very good quality, it can be hammered on its edge when cold, whereby this curve is imparted to

it. If the spring be now bent to take the form of the pelvis, the lower edge being longer than the upper, the truss slants at the back in correspondence with the slope of the sacrum.* In inguinal trusses the inclination of the spring in front is the same as that of the pad. The abdominal wall in the erect posture is not flat in the inguinal region, but springs forwards from Poupart's ligament with a bold curve, so as to give the inner ring a direction very much downwards as well as forwards (Fig. 12). Therefore the truss must be curved to face somewhat upwards as well as backwards to adapt itself to this conformation.

Construction of the Pad.—The spring is united by two rivets to the plate of soft iron which forms the foundation of the pad. In early times, and even so late as Camper, the pad plate, or "platine," as Lequin named it, was placed more or less at right angles with the spring. This disposition is very slight in Lequin's truss, but very marked in Camper's, whose inguinal pad came far below the crest of the pubes. The upper border of the spring and of the pad plate have generally been placed in the same line, and the various alterations, introduced from time to time in the shape of the pad, have been made at the expense of its lower border.

The importance of fixing the Pad to the Spring immovably.—Some have thought it advantageous that the spring and pad plate should not have a fixed attachment, but that the position and inclination of the pad should be capable of alteration at the will of the surgeon. For this purpose the pad has been furnished with screws and slots or sliding bars, and many other contrivances having the same intention. The adjustment of the pad is thus not only in the power of the surgeon, but also of the patient, which is a very undesirable arrangement. A patient has no knowledge of the parts concerned in hernia, and, therefore, it is often difficult even to teach him how to put on a truss. He is quite incapable of making the required modifications in it, which he will certainly endeavour to do if the means are under his control. For this reason, and for the still more important one, that a connection between the spring and pad which is not immovable puts in jeopardy the stability of the latter, it is impossible to recommend any truss in which the spring and pad plate are not so firmly united as to form practically one piece of metal.

The Alterations that can be made in a Truss at the Time of Application.—The only alteration which we are ever called upon to make in the truss, when it is about to be applied, consists, so far as I am aware,

* It is customary with the best truss-makers to hammer the whole spring cold to increase its toughness. N. Lequin particularly recommends this proceeding (*op. cit.*, p. 97), and says that the truss has more strength the more it is worked "like a hammered cuirass." The hammering mentioned in the text is additional to the general hammering which Lequin directs.

in increasing the upward inclination of the pad. Sometimes the belly sweeps forwards so abruptly from Poupart's ligament that the inner ring and the inguinal canal look directly downwards, and therefore the pad must face almost directly upwards.

The pad plate is of soft iron, and can be bent a little across the back of a chair, and by holding the truss between the knees and giving the pad a twist its inclination upwards can be still more increased. But it is not often necessary to practice this manœuvre.

Construction of the Pad.—In constructing the pad four things are to be considered—the materials of which it is composed, its shape, its size, and its prominence.

Its Material.—The substances which have been used for the pad are very various. Malgaigne classified them as soft, elastic, and hard.[9] The soft materials are now generally rejected. The elastic pads are (1) those in which an elasticity, independent of that of the truss spring, is obtained by adding springs to the pad; or (2) by covering the pad with indiarubber, filled with air or water.* These elastic pads are usually comfortable to the wearer, and thus fulfil one of the requirements of a good truss; but they are wanting in security, as before observed. If air is used, it escapes. All these pads tend to flatten out and lose shape. The solid pad is free from these defects, and if worn in the right place is perfectly comfortable. It has been made of wood, ivory, metal, caoutchouc, and cork. The last is the lightest, is most easily worked, and is the material most commonly used.

Its Shape.—The shape of the pad should be determined by the parts which it is intended to cover. In inguinal hernia the inner ring and the canal must both be closed, and, therefore, the pad must have a somewhat elongated figure. Along the upper border of the truss there need be no change of direction at the junction of the spring and pad, but the lower part of the pad should be inclined a little downwards to correspond with the obliquity of the inguinal canal.

Its Size.—N. Lequin recommended that the pad for inguinal hernia should be as small as possible. He noticed that a large pad is subject to displacement every time the thigh is flexed, and, he says very truly, there is not room for it in the groin. On the other hand, if the pad is very small, it is not stable. Malgaigne observes that the thumb is of sufficient magnitude to close the inguinal canal and inner ring, but that the pad must be larger than this, and rest upon the parts around for a little distance to acquire steadiness.

Its Prominence.—There has been great diversity of opinion as to the amount of prominence to be given to the pad. Some make it almost flat. When it is remembered that a protrusion not only pushes forwards

* Heritz and Laval, in 1771, proposed an air pad. (Richter, *op. cit.*)

the anterior wall of the inguinal canal, but also bulges the posterior wall towards the abdominal cavity, it is evident that the pad must project so far as to keep the walls of the canal in close contact. Flat pads not only fail to do this, but their effect is diffused, and they act equally on the sound and the unsound parts.

If we bisect the whole truss, so as to divide it into an upper and a lower half, the greatest prominence of the pad should be in the line of bisection. Thus the power of the spring acts most directly along the line of greatest prominence in the pad; and this line of elevation in the pad should correspond to the inguinal canal and inner ring. Moreover, the pad should increase in prominence from the inner ring along the inguinal canal, because the bulging of the abdominal wall is slight at the internal ring, and becomes greater and greater towards the external ring.

A Table is here given of the dimensions of the pad which have been found most effectual at the Truss Society, according to the length of the truss. These measurements have been made from the truss in its finished state. The line of junction of the spring and pad can be felt and seen through the leather covering, so that the length of the pad can be easily determined.

Table showing the Dimensions of the Pad according to the Length of the Truss.

Ordinary Inguinal Truss.						Ordinary Femoral Truss.					
Girth of Truss.	Size of Pad.					Girth of Truss.	Size of Pad.				
	Length.		Breadth.		Thickness.		Length.		Breadth.		Thickness.	
Inches.	I.	L.	I.	L.	I.	L.	Inches.	I.	L.	I.	L.	I.	L.
28	3	6	1	9	1	1	27	3	0	1	8	1	1
29	4	0	2	0	1	2	28	3	0	1	8	1	1
30	4	3	2	1	1	4	29	3	6	1	10	1	3
31	4	3	2	2	1	4	30	3	6	1	11	1	3
32	4	3	2	2	1	5	31	3	6	1	11	1	3
33	4	3	2	3	1	5	32	3	6	2	0	1	3
34	4	3	2	3	1	5	33	3	9	2	0	1	3
35	4	5	2	4	1	5	34	3	9	2	1	1	4
36	4	5	2	4	1	5	35	3	9	2	2	1	4
37	4	5	2	6	1	5	36	3	9	2	2	1	4
38	4	5	2	6	1	6	37	3	10	2	2	1	4
39	4	6	2	6	1	6	38	3	10	2	3	1	4
40	4	6	2	6	1	6							

The measurements are given in inches and lines.

The length of the pad is measured from its innermost border to the junction of the spring and the iron plate supporting the pad. This line of junction can be felt through the leather covering.

The breadth is measured from the upper edge to the lower edge of the pad at its widest part.

The thickness is measured from the most prominent point of the pad to its anterior surface.

Coverings of the Truss.—To complete a truss, after the spring and pad plate have been united and shaped, and the cork applied to the latter, the whole is covered with one or more layers of coarse flannel, and then with leather. The surface which is to be next the body is generally covered with chamois leather. The stitching is so placed that it does not rest anywhere against the skin. The extremity of the spring is connected with the pad by a thong of leather continuous with the covering of the truss. The thong is button-holed and fastened to a stud or hook on the pad. The position of this stud or hook was originally in the middle of the pad; but it is now usually placed near the upper border, not far from the line of junction with the spring. The object of this position is to prevent the truss from rising upwards, to which it has a strong tendency.

The Understrap.—At the lower and inner part of the surface of the pad is a second button, to which the understrap is fastened.* This is a narrow band or strap attached just behind the shoulder of the truss and carried along the fold of the buttock up to the pad in front. Some prefer to fix it at the back of the truss. This is objectionable; for, when any strain comes upon it, it tends to depress the truss behind, and, consequently, to evert the lower border of the pad in front, thereby rendering the hernia less secure. If the understrap is placed just behind the anterior superior iliac spine, it tends rather to tilt up the pad in front from off the pubic crest, which is much to be wished. Its principal use, however, is to assist in keeping the pad in position, and it is of so much service in this way that it must be considered an essential part of the truss. The understrap need not be tight; indeed, if it is applied tightly, the patient will discontinue its use.

A Double Truss in old times was made with one spring, as for a single truss, carrying two pads. The pad nearest the spring was placed over the larger of the two ruptures. The double truss is now made with one spring embracing the pelvis, having a pad at each extremity.† Sometimes a separate spring is made for each side, and the two are connected at the back by flanges. A truss made in this way is a little stronger than one with a single spring, but does not fit so well behind, and is more liable to rust.

Decay of Trusses.—The chief cause of decay in trusses is oxidation, and there are no means in common use to prevent it. Nickel-plating has been tried without success; for the truss must be heated during the process, whereby the temper of the steel is altered.

Mr. Gustav Ernst tells me that he has used platinum-plating with very

* The understrap was introduced by Lanfranc. (Lassus, *op. cit.*, vol. i. p. 119.)

† Typhaine invented the double truss, with each pad on a separate spring. (An. Boursier, Dict. Encyclop. d. Sciences Med., 1888, vol. xiii. p. 751.)

satisfactory results; and as it can be applied cold, it does not damage the elasticity of the spring. I learn from Mr. Pebardy that the Egg truss had no covering, but that the steel was silver-plated and applied next the body. Both the last-named processes increase very much the cost of a truss. Lasserre suggested covering trusses with gum elastic,[10] and this is now generally done for bath trusses. It is not, however, so comfortable to wear as leather.

Femoral Truss. The spring of a femoral is lighter than that of an inguinal truss, but the chief difference between the two is seen in the arrangement of the pad. The femoral ring is a small direct opening, so that there is no occasion to lengthen out the pad as in the inguinal truss. The femoral pad is, thus, much smaller than the other; it is more inclined downwards, as it rests altogether below Poupart's ligament; it must face almost directly upwards, because the plane of the femoral ring in the erect posture is almost horizontal; and, in order to avoid pressure on the femoral vessels, the pad, though small, should have considerable prominence. The studs are placed in the same relative position as in the inguinal truss.

The Efficiency and Easiness of the Truss. In the foregoing remarks I have not deemed it necessary to describe in detail the manufacture of trusses, and have only referred to those facts which concern the efficiency and the easiness of the instruments. For it is these considerations which occupy the surgeon when he is called upon to advise a truss. His duty then requires him to choose that which will be most comfortable and most secure. Comfort is essential to safety, because patients neglect to wear an instrument which makes them uneasy. No truss can be thoroughly trustworthy which is not perfectly comfortable. A truss may be quite easy to the patient, but insecure; and it is thus that the patent trusses err, because they usually sacrifice safety to comfort. For mild bubonoceles they may suffice, so long as the patient avoids exertion; but in emergencies they cannot be relied upon. Either they oblige a man constantly to give heed to his steps and make life burdensome, or they give him a false sense of security and put his life in danger.

The Action of the Truss is intended not only to retain the rupture, but also to close the opening so perfectly and constantly that the parts are placed in the most favourable condition for cure. It was formerly supposed that the pressure of a truss might excite inflammation in the underlying parts and cause occlusion of the passage. Some instruments were specially devised for this purpose, and an account of them is given in the Report of the Philadelphia Medical Society in 1837. But there is no sufficient evidence that truss cure results in this way. It has been shown in a former chapter that cure occurs almost solely during the period of development. If the hernia is kept completely reduced,

the parts during growth recover themselves or acquire the necessary power of resistance, whilst the peritoneal diverticulum (sac) either recedes or becomes obliterated. Some surgeons hold that the ruptures of infancy and childhood can be certainly cured by an instrument, and that the parents may be promised a cure. The evidence in support of this contention is very difficult to lay hold of; but, on the other hand, there is evidence that a large proportion of early ruptures are not cured, at least in this country.

If Table I. is again referred to, the number of males ruptured under eleven years of age can be found in Part I. (= 4218). In Part II. the number of ruptured males who visited the Society before they had reached eleven years is seen (= 2825). By subtracting the last total from the first (= 1393) we have the number of persons ruptured before eleven years of age who applied for relief at some period after eleven years of age, and were consequently not cured. That is, 33 per cent. of the herniæ occurring under eleven years were not cured; and it is obvious that this 33 per cent. is the minimum of those uncured, and that the full proportion is probably greater.*

Therefore, it appears to me that a surgeon would not be prudent in promising a cure to any patient, no matter how young; but he may safely promise to almost all patients with oblique hernia that if the truss is worn with due care, the hernia will be so far cured that they will not be conscious of the rupture so long as the instrument is used. According to my observations, this may be said of the worst scrotal ruptures, even when the patient is advanced in years; but much more care and pains are required of the patient to achieve this result, if the rupture has reached a large size.

The improvement takes place gradually. A hernia which has been scrotal becomes a bubonocele, and at length ceases to appear; but it very soon gives warning of its return if the truss is laid aside. In a few cases the cure is so perfect that no protrusion occurs, though the instrument is discontinued. With direct and with femoral hernia the amelioration after wearing a suitable truss is not by any means so certain as in oblique inguinal, and the prognosis in those cases must always be guarded.

Cases in which a Hernia cannot be Retained.—When it is said that a rupture cannot be retained by a truss, it is generally because

* In the same way it may be shown that the minimum number of cases not cured increases as the age advances.

For under	11	33	per cent. are uncured.
,,	16	36	,, ,,
,,	21	38	,, ,,
,,	26	44	,, ,,

there is a defect in the instrument or a defect in its application. Every protrusion in the groin can be kept under restraint by mechanical means; but to this there are three exceptions. Firstly, when there is ascitic fluid in the belly which descends into the sac, it cannot be prevented by an instrument from trickling down after reduction. No truss will keep up fluid. Secondly, in certain cases late in life, when death is approaching, the health begins manifestly to decline, though no definite illness declares itself. The patient loses flesh, his appetite fails, and he looks ill. If such a person has a rupture, it soon becomes very troublesome; it is constantly down in spite of the truss, and nothing that the surgeon can do will keep it up. The tissues are so lax and the viscera so slippery that no machinery will hold them. Thirdly, in certain cases of direct hernia the protrusion cannot be retained till after a long course of treatment. But for these three exceptions, every rupture which has not been subjected to operation can be retained by a truss. It occasionally, but rarely, happens that a surgeon makes a very wide division of the stricture during herniotomy, and, as a consequence, the patient suffers ever after from an uncontrollable protrusion. Arnaud once made too large an opening when operating on a woman for strangulation, and she afterwards brought an action against him for damages at the instigation of a medical *confrère*. Her case was one of those that could not be retained.

REFERENCES TO CHAPTER XXIV.

Part I.

1. **Camper.**—Ueber die Verfertigung der Bruchbänder, Kleine Sch., 1785, ii. 86.
2. **Gordon.**—Malgaigne, Leç. Clin., 1839–1840, p. 83.
3. **Marc Gatinaria.**—Lassus, De la méd. opér., 1795, i. 115.
4. **Nicolas Lequin.**—Tr. des Her., 8th Oct. 1665, 12mo.
5. **Dionis.**—Chirur. operat., trans. from the Paris ed., 1710, p. 183.
6. **T. Sheldrake, jun.**—Obs. on the Treat. of Rup., 1784, p. x.
7. **T. Brand.**—The Causes and Symp. of Rup., 1782.
8. **Camper.**—Mem. de l'Acad. Roy. de Chir., 1774, xv. 63; also Kl. Schr., ii. 79.
9. **Malgaigne.** Op. cit., p. 107.
10. **Jobert** (de Lamballe).—Tr. Mal. Chir. du Can. Intes., 1829, i. 346.

PART II.

THE APPLICATION OF TRUSSES.

To Measure for a Truss.—When a patient is to be measured for a truss he should be lying down, because the belly falls forwards in the erect posture, and the measurement is then apt to be too large. The tape should cross the base of the sacrum, and come forward just below

the crest of the ilium to the middle line in front. If the tape follows the direction given to it by the iliac crest, it inclines a little downwards in front and the ends meet above the pubes (see Plate XIII.). The tape should be drawn tight, for the most common error is to make the size too large. This mode of measurement serves for inguinal or femoral hernia, and for every kind of truss used for these herniæ. No attention need be paid to the hernial orifices. The length of the single truss, whether inguinal or femoral, should be the same as the length of the measurement; but as a double truss loses a little in girth by its coverings, we must add an inch to the actual measurement when ordering an instrument for double hernia. The patient should always lie down when a truss is about to be applied.

The Application of Trusses for Reducible Inguinal Hernia.

If the Hernia is Bubonocele.

There is no essential difference in the mode of putting on or in fastening a single and a double truss; and, therefore, to illustrate each case, I will refer to Plate XIV., which shows a double inguinal truss in position. Before all things see that the understrap is placed just behind the shoulder of the truss. In the Plate it is just hidden from view on each side of the pelvis. Pass the truss beneath the small of the back and bring the pad or pads round to the front of the belly.

For one who is not constantly in the habit of adjusting trusses it is needful to define the crest of the pubes by placing one index finger upon it. Having clearly defined the crest, draw down the pad with the other hand so that its lower border may rest immediately above the pubes, and its inner extremity just in contact with the outer edge of the rectus. Then fasten the cross-strap to the top button of the pad, and bring the understrap along the fold of the buttock under the thigh up to the front and fasten it to the lower stud. If the understrap is tight the patient will not wear it. The truss should be just below the crest of the ilium all the way round, so that it may take a firm grip of the pelvis.

The directions here given for wearing the pad above the pubes were first taught by N. Lequin, who explained very well the reasons for so doing.[1] But this detail was afterwards overlooked till Sir Astley Cooper again drew attention to its importance. Even at the present day it is not always observed. If the pad is worn low, it rests on the pubes, and cannot exert pressure on the inner ring and canal. These parts are left comparatively unprotected, so that, though the external ring is closed, the viscera may enter the sac for a short distance, notwithstanding the truss,

and the patient be in a very unsafe predicament. Another objection to wearing the pad low down in front is that the skin is squeezed between it and the pubes, and becomes sore. M. Nicaise found a bursa over the crest of the pubes in a man who had worn his truss over the bone.[2] Many have supposed that the pressure of the truss is likely to injure the spermatic cord, but, in spite of this opinion, they have not in general attended to Sir Astley Cooper's admonition to place the pad above the bone. The danger to the cord, however, is purely imaginary, for hundreds of patients wear the pad habitually on the pubes, and suffer no damage to the cord or testis. Scarpa thought that the cord in direct hernia was especially subject to pressure, and designed a pad in the shape of a horse-shoe with a cleft for its reception.[3] This idea was adopted by the late Professor Wood, and a truss after this pattern is sold at the present time under the name of Wood's truss. The instrument is faulty in many respects, and the provision for the protection of the cord altogether superfluous.

The general directions given to a patient on supplying him with a truss will be, that it must be worn high up behind, high up in front, and just below the haunch bones. It is the second of these instructions which the patient has most difficulty in following. If the truss is uncomfortable, or fails to keep up the rupture, it is, as a rule, because the pad is too low down in front. The instrument need not be worn at night if the patient has no cough, and if the hernia remains reduced when he is recumbent. It should be put on before he rises from bed, and taken off when he lies down.

If it is necessary to wear the truss night and day, it must be taken off at least once every day that the patient may wash. If this is not done the skin becomes sore, blebs appear, and the truss may have to be laid aside for a time. M. Gosselin saw a child eight years old whose truss was left on for fifteen days. A large slough was found under the pad, tetanus supervened, and the child died.[4]

During infancy the truss must be covered with indiarubber instead of leather, so that it may be dried every time the child wets it, and readjusted. If this is not done, the part soon gets sore. Throughout infancy and childhood a truss should be worn night and day, or little benefit will accrue. Some have imagined that very young children cannot wear a steel truss, but this is quite erroneous. Directly the rupture is discovered, a truss should be applied; if the nurse takes pains to keep the body and the truss dry, the child will not suffer in any way.[5] In infants the truss must not be fastened tightly. In adults it should fit as closely as a glove; but in children it must be much looser than this, and the understrap especially must be slack.

Management of Truss when Testis is arrested.—In cases of hernia

the testis may be arrested in the canal or just outside the external ring, both in the child and in the adult. Some have supposed that a truss cannot be tolerated under these circumstances, or that the instrument will prevent the final descent of the organ,[6] or that atrophy of it will result from the pressure.* In the majority of these cases the testis has no more than the ordinary amount of sensibility (see page 132), and, wherever the testis may be, a truss can be worn, without in the least incommoding the patient. After the reduction of the rupture, the testicle takes up a position either inside or outside the canal, and, even when the organ is extremely sensitive, it does not, as a rule, resent the presence of a truss. Among many hundred cases of this kind treated by the author, he has met with only one in which the patient complained of pain when the truss was applied over the canal, containing a hyperæsthetic testis. This man, however, refused to part with his testicle. If the tender organ be below the external ring, the truss cannot interfere with it. As a matter of fact, the surgeon, when adjusting a truss, may altogether neglect the testicle. The notion that a truss may cause atrophy of a belated testis has probably arisen from the circumstance that these testes are generally small and ill-developed. If the testis has a tendency to descend into the scrotum, the truss is powerless to prevent it, and the surgeon need be under no apprehension that the instrument will interrupt the course of nature.

If the Hernia is Scrotal.

A scrotal rupture may be retained occasionally by an ordinary truss, but, as a rule, it requires an instrument of greater capability. The rat-tail truss is most commonly used for this purpose (Plate XV.). The spring of this truss is a little stronger than that of the ordinary one, and there are several differences in the arrangement of the pad. The inguinal canal and rings are more dilated in scrotal hernia than in bubonocele, and, therefore, the pad should be larger and fuller; and as the internal is nearer the external ring, the impact of the viscera is more directly downwards, so that the pad must face more distinctly upwards. As, moreover, the hernia tends to escape at the external ring, the pad is continued downwards over the pubes, and is made to terminate in an understrap or tail, which is fastened to a hook near the shoulder of the truss (as shown in the Plate).

The pads of these trusses, as usually made, are triangular, and the iron work is carried down to the apex of the pad. The iron thus rests on the crest of the pubes and prevents the part above from exercising

* De Launay observed that the testis is in peril if a truss is worn over it (*loc. cit.*, p. 25).

due pressure on the canal. The iron work of the pad plate should descend no further than in an ordinary truss (it corresponds to the line of the stitching in Plate XV.), and all the part below should be made up of stuffing. If this is done, the lower, soft part of the pad bends over the pubes and closes the external ring, whilst the upper portion is not hindered from making pressure on the inguinal canal and inner ring.

It will be observed in Plate XV. that the upper button is omitted, and that the cross-strap is fastened to the button, which is the lower one in an ordinary truss. With scrotal hernia the lower and inner portion of the pad is subject to great pressure on cough, &c., and if the cross-strap is fastened as in Plate XV., it assists the upward pressure of the pad.

The majority of scrotal herniæ can be treated successfully with a truss of this description. If the instrument is worn night and day, being only taken off for washing the body, the hernia gets so much better that it becomes again a bubonocele. The external ring contracts, so that at length the index finger cannot be introduced into the canal, and an ordinary truss can then be applied.

In bad cases the hernia slips below the pad at first; sometimes several times a day. The patient must be told to push the rupture back directly it comes down, and to continue wearing the truss day and night. Improvement will be gradual. As time goes on, the protrusion will descend less and less often, till it ceases to come down altogether. The patient should not lie up, but go about his ordinary avocations. Everything that improves the state of his health hastens the amendment of his rupture.

The patient cannot expect to obtain the result above described unless he is prepared to co-operate with the surgeon, and follow his directions implicitly. Unfortunately, it is, as a rule, careless persons who suffer from these troublesome ruptures, and it is often difficult to persuade them to mend their ways. No man can help being ruptured, but every man can help having a bad rupture.

Scrotal Hernia in Infants can be generally retained by an ordinary truss, but occasionally a rat-tail must be used. In them the amelioration is more rapid than in adults, and the worst ruptures in children can always be brought under control in a few weeks, by observing the directions above given. Cases, of which I have read, of ruptures in children which no truss would keep up, are unknown to me in practice.

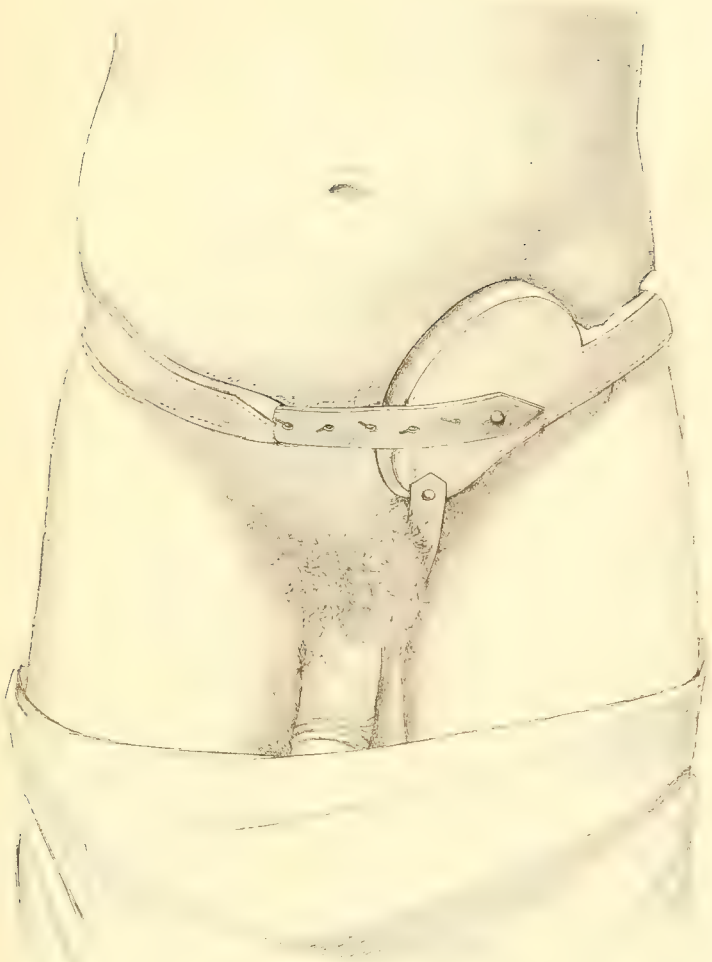
Direct Hernia, though rarely scrotal, generally requires a rat-tail truss, and it should be worn a little overlapping the edge of the rectus muscle.

In certain exceptional cases of scrotal hernia, when the opening is large and the contents of the sac very slippery, it is necessary to order

A [illegible]
[illegible]alled the forked t[illegible]

[illegible] sculp

Danielsson & Co. sculp.



the maker to strengthen the spring of the truss. This can be done only to a slight extent, for the limit is soon reached when the pressure is unbearable.

If the opening into the belly is very large, it sometimes happens that, though a rat-tail is used, the rupture escapes at the inner side of the pad towards the middle line. To obviate this, a truss, called "a forked tongue" (depicted in Plate XVI.), was devised by Mr. Kingdon, which differs from the rat-tail in that the pad is carried inwards for a considerable distance and forms a tongue, which is fixed by a thong to the cross-strap near the anterior superior iliac spine of the sound side.

The patient shown in Plate XVI. is wearing the truss with the hernia reduced. His state before reduction is seen in Plate VI.

In a case of Double Rupture, one of which is Scrotal, it is not usually advisable to use a truss having an ordinary pad on one side and a rat-tail on the other. It is best, as a rule, to have a double rat-tail truss, as seen in Plate XVII., which is really a double-forked tongue. In applying this truss, place the pads in position so that the lower edge of the stitching, that is, the iron plate of the pad, is on a level with the upper border of the pubes; next fasten the cross-strap, and then fix the understraps.

The last case that requires notice is the reducible **Interstitial Hernia.** In order to retain it the pad must be extended upwards, as in Plate XVIII. The rise of the pad should begin just internal to the anterior superior iliac spine. When this rupture also descends to the scrotum, it is necessary to add a tailpiece to the inner and lower angle of the pad.

The Application of Trusses for Reducible Femoral Hernia.

In applying a Femoral Truss it must be observed that if the measurement is at all too large, the inner edge of the pad presses against the spine of the pubes and causes pain and soreness. Secondly, the understrap should be further forwards than it is on the inguinal truss (see Plates XIX., XX.). By this arrangement every pull on the understrap tends to tilt the pad and cause it to face upwards, in correspondence with the horizontal position of the femoral ring.

In Plate XIX. a light form of femoral truss is seen which is very comfortable and efficient when the hernia is of moderate size; but the pad is so small that care must be taken to place it exactly over the femoral canal. The cross-strap should be fastened first, and afterwards the understrap.

A more ordinary form of femoral truss is seen in Plate XX., where a double truss is delineated. The single truss of this pattern is of the same shape, and is fastened in the same way. The understraps in both

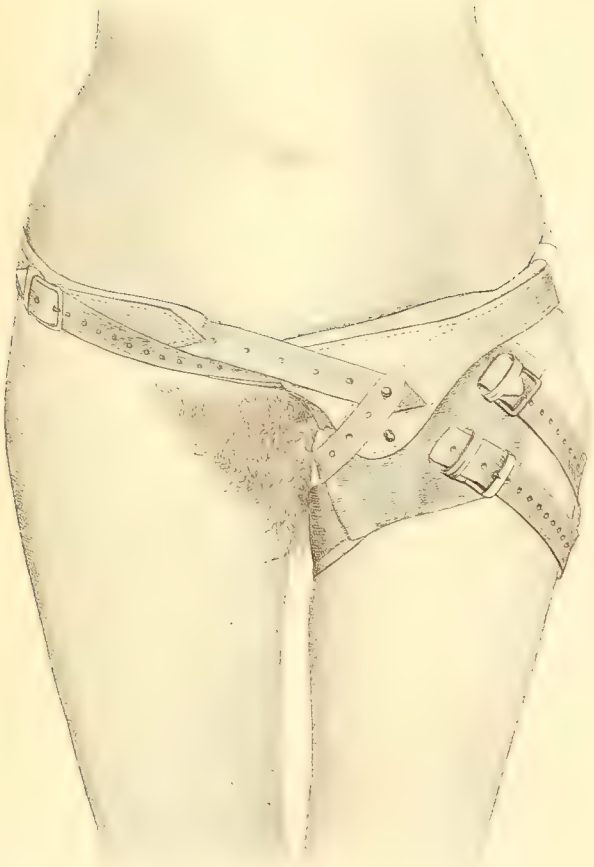
single and double femoral should be fastened to the top button in order to increase the tilting of the pad upwards.

When a femoral hernia is of large size, no ordinary truss, such as those just referred to, will control it. Whatever direction the protrusion takes, it is necessary, firstly, to add to the lower border of the truss a thigh belt (see Plate XXI.). This appears to have been introduced by Sir Astley Cooper, who makes a brief allusion to it at page 7 of his work on Crural Hernia. The thigh belt should contain a triangular extension of the pad downwards, which, when firmly stuffed, dips into the groove which the hernia has made for itself in the thigh and prevents the escape of the viscera below. It is generally sufficient to add to the truss the thigh belt, and if the femoral ring is large to increase a little the fulness of the pad. Sometimes, however, when the rupture is prevented by the belt from descending the thigh, it escapes above the upper border of the truss. When this happens, an inguinal piece must be added to the truss, as in Plate XXI.; and, as the parts tend to come out, not only upwards, but also upwards and inwards, the inguinal fulness must be constructed to resemble the forked-tongue truss. A truss with a thigh belt and an inguinal fulness over is also required when an inguinal hernia accompanies a large femoral on the same side. When these trusses are adjusted, the thigh belt should be fixed first, next the cross-straps, and then the understrap.

When an Inguinal Hernia is on one side and a Femoral on the other, an ordinary double femoral truss can generally be used. A double inguinal with one pad drawn down to cover the femoral canal is not applicable, because the pad is too large, and does not possess the necessary inclination downwards. A double femoral truss should be applied with both straps fastened to the top button on the femoral side, and both fastened to the bottom button on the inguinal side. The pad can thus be kept in position over the inguinal canal.

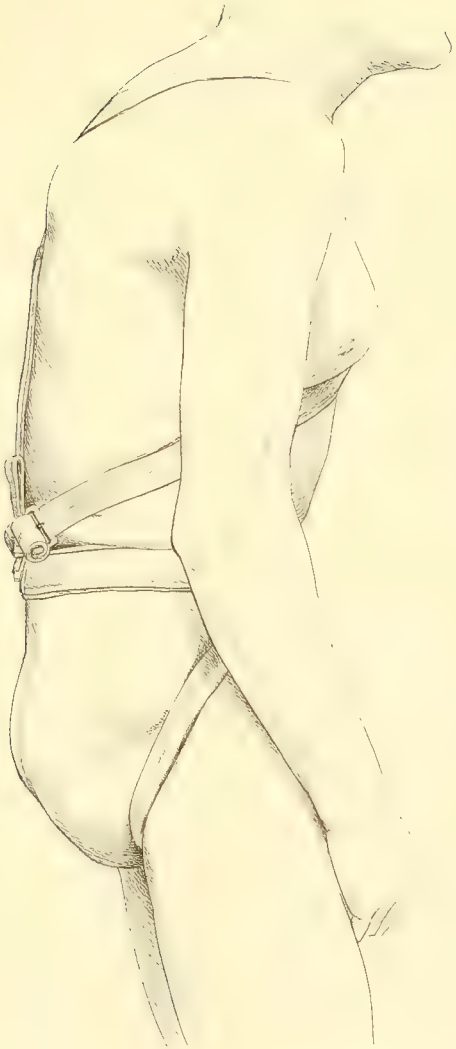
When a large Femoral is on one side, and a Scrotal on the other, a truss must be used combining a rat-tail or forked tongue with a femoral having a thigh belt.

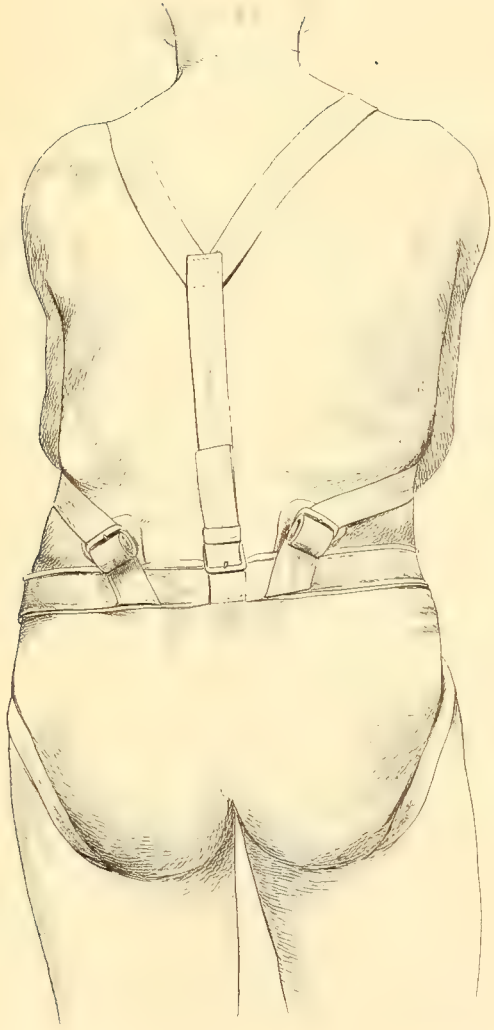
Management of Truss in Old Persons.—There is sometimes a difficulty in keeping up the ruptures of old people, whether inguinal or femoral, owing to the slipping down of the truss behind. Whatever may be the graces which accompany old age, it sadly mars the beauty and even the dignity of the figure. Generally the buttocks so completely fall away (Plate XXII.) that the truss sinks down over the sacrum. Its lower edge in front is thus everted, and the rupture escapes. To remedy this, it is not sufficient to carry a brace from the truss behind over the shoulder to the truss in front, for the instrument would then tend to assume a horizontal position. The brace, or lifting strap, shown in



Femoral truss with thigh belt & inguinal fulness.
The line of shading on the pad shows the curve
of the femoral truss and marks out the inguinal
portion which has been superadded.

Danielsson & Co. sculp





To show the arrangement of the lifting

Plate XXIII., rises from the middle point of the back of the truss and divides into two parts, one going over each shoulder. These two bands cross over one another on the front of the chest and descend to be buckled on each side to the truss behind the line of its transverse diameter.

If the position of the instrument at the back is not attended to, the patient will not derive any benefit from his truss, however excellent it may be in itself. In old persons who are so thin as to need the assistance of a lifting strap, if the rupture is such that the truss must be worn night and day, the lifting strap must also be worn night and day.

Choice of a Truss.—It is very difficult for one who is not constantly using trusses to decide at once on the kind of truss needed in any particular case, and there seems no other way but to try the simpler form first, and, if it fails, to apply one of a higher grade. I have endeavoured to point out what kind of truss is best adapted for the different kinds of rupture, but no verbal description can fully supply a deficiency of practical experience.

Patient to continue his Occupation.—The patient, whatever his rupture may be, should not be required to alter his mode of life or desist from the employment and the exercises to which he has been accustomed. If properly trussed, all that he did before he was ruptured he may continue to do, with impunity, afterwards.

REFERENCES TO CHAPTER XXIV.

PART II.

1. **N. Lequin.**—Op. cit., p. 74.
2. **Nicaise.**—Rev. de Chir., 1886, p. 573.
3. **Scarpa.**—On Her., tr. Wishart, 1814, p. 114.
4. **Gosselin.**—Sur les Her. Abd., 1865, 376.
5. **Pott.**—Tr. on Rupt., 1763, 2nd ed., p. 41.
6. **Gosselin.**—Op. cit., p. 372.

CHAPTER XXV.

ON IRREDUCIBLE HERNIA.

Causes of Irreducibility.—In an irreducible hernia the function of the bowel continues undisturbed though the protruded parts cannot be put back.

If the contents of a rupture are allowed to remain in the sac, they are apt (1) to acquire adhesions to one another or to the sac wall; or (2) the

parts in the neck of the sac may suffer diminution of size in consequence of the pressure to which they are subject, and a disproportion arises between the contents of the sac and the passage through which they have come. These are the two chief circumstances which prevent the reduction of a rupture. When the contents of the sac adhere to one another, they are generally but not necessarily irreducible. When the contents adhere to the sac wall, they are irreducible, unless the connecting tissue is long, in which case reduction may be effected, but then the scrotum or skin is drawn up towards the mouth of the sac. If adhesions exist at the neck of the sac, reduction is impossible. It happens in rare cases that bands crossing the sac prevent reduction.

Under the second cause of irreducibility come those not infrequent cases in which the omentum in the neck of the sac has dwindled to a mere cord. This condition creates a serious obstacle to reduction. The same change in rare instances occurs in the mesentery.

Sometimes the omentum increases in volume and thus becomes too large to pass the neck of the sac, and in very exceptional cases the muscular coat of the intestine which lies in the sac becomes so much hypertrophied that the same difficulty is occasioned. When the sigmoid flexure or great intestine occupy the sac, the appendices epiploicæ sometimes enlarge to such an extent as to prevent reduction. Such cases have been recorded by Hartmann, Peyrot, Bonilly, and others. One of the most remarkable is that described by Prengrueber, who found in the hernia of a child, four years of age, a mass, like a piece of omentum, consisting of an appendix epiploica, which had undergone hypertrophy and prevented the return of the bowel.[1] Tumours and tuberculous glands developed in that part of the mesentery which is within the fundus, have been known to interfere with reduction.

A Transitory Condition.—Though a hernia may be irreducible, even for a number of years, the condition is, as a rule, transitory, and seldom, if ever, lasts during the whole lifetime. On account of the temporary duration of irreducibility, it is difficult to tabulate such cases with complete accuracy. In the accompanying Table each case has been entered, as nearly as can be, under the age at which the patient stood when his hernia became irreducible (Table XXV.). The cases have been taken from the patients seen at the Truss Society in 1888, 1889, and 1890, and have been already included in Tables I. and II.

Age of Occurrence.—It will be observed that under sixteen years of age a hernia is seldom irreducible, only .37 per cent. of the males with inguinal hernia being subject to it. The reason for this, no doubt, is that herniæ in early life are chiefly enteroceles which have little disposition to form adhesions. Irreducibility is most common between the ages of thirty and sixty in both sexes, and in both kinds of hernia. Taking the

TABLE XXV.

Cases of Hernia which were seen at the Truss Society in 1888, 1889, 1890, *entered according to the Age of the Patient at the time the Hernia was Irreducible.*

Inguinal Hernia.—Males.

	Total.	Under 16	16-20	21-25	26-30	31 35	36-40	41 45	46-50	51-55	56-60	61-65	66-70	71-75	76-80	81-85
Right	109	13	6	8	6	8	10	10	18	9	9	7	4	1	...	...
Left	67	5	4	3	6	9	7	7	6	3	4	6	4	2	...	1
Total	176	18	10	11	12	17	17	17	24	12	13	13	8	3	...	1

Females.

Right	7	1	...	...	...	1	2	1	1	..	1	...	...	...	...	...
Left	4	...	1	...	...	1	...	1	...	...	1	...	...	...	...	..
Total	11	1	1	...	...	2	2	2	1	...	2	..	...	...	...	...

Femoral Hernia.—Males.

Right	26	...	...	1	...	2	2	2	5	4	3	5	1	1	...	...
Left	23	...	1	2	...	1	2	3	1	5	1	3	3	1	...	...
Total	49	...	1	3	...	3	4	5	6	9	4	8	4	2	...	...

Females.

Right	85	...	4	6	7	11	12	17	5	9	6	4	3	...	1	...
Left	53	...	1	2	2	7	6	13	6	10	5	1	...	...	...	..
Double	3	...	...	...	...	...	...	1	...	1	1	...	...	...	...	...
Total	141	...	5	8	9	18	18	31	11	20	12	5	3	...	1	...

patients of all ages, 1.003 per cent. of inguinal herniæ are irreducible in males, and .61 in females; whilst of femoral herniæ 10.6 per cent. are irreducible in males, and 11.7 per cent. in females. Therefore femoral herniæ become irreducible more than ten times as often as inguinal.

Omentum most often Irreducible.—It has already been observed that of all the contents of a rupture the omentum is most commonly irreducible. Among 286 of the cases in Table XXV. the nature of the contents was noted, and in not less than 90.2 per cent. the omentum was irreducible. There is no marked difference in this respect between inguinal and femoral hernia (see Table XXVI.). In cases of entero-epiplocele the bowel is generally reducible, whilst the omentum remains fixed in the sac.

TABLE XXVI.

Showing the Parts irreducible in those Cases of Table XXV. *in which the Nature of the Contents was noted.*

	Male Inguinal.	Male and Female Femoral.
Irreducible omentum	120	71
,, omentum with reducible gut	23	44
,, enterocele	3	5
,, entero-epiplocele . .	15	5
Total . . .	161	125

Treatment.—Up to the beginning of the last century irreducible ruptures were generally treated by a suspensory bandage which was intended to prevent their increase, but could do nothing towards effecting their return. In the seventeenth century, William Arnaud, the great uncle of George Arnaud, and surgeon to Gaston of Orleans, the brother of Louis XIII., discovered that by keeping up constant pressure on an irreducible hernia the contents at length go back.[2] For this purpose he made trusses with a concave pad, "bandages a cuiller." In later times, when a truss was required for a large irreducible rupture, it was made fenestrated, that is, its circumference only was formed of metal, and its area was covered in with chamois leather, "brayers en raquette."[3] Trusses of these two kinds are still used for irreducible femoral hernia.

Treatment of Irreducible Femoral.—As a femoral hernia which resists reduction is seldom of large size, a pad can be used in the majority of cases very little larger than the ordinary convex pad. If the rupture has attained such proportions that an ordinary hollow pad will not cover it, a truss must be made for the case, and it should be

observed that the measurement for the pad must be taken from the outside limits of the hernia both transversely and from above downwards, for the covering of the truss encroaches somewhat on the concavity of the pad, and therefore the full measurement must be given.

A hollow pad may be applied to a femoral hernia, and to an irreducible bubonocele, but it is evident that it cannot be used for an irreducible scrotal hernia. The latter herniæ are of frequent occurrence, but a bubonocele is hardly ever irreducible.

Treatment of Irreducible Inguinal.—The difficulty of keeping up pressure on a scrotal rupture, which cannot be returned, induced Mr. Kingdon to invent in 1867 a truss to accomplish this purpose. It is delineated in Plate XXIV., and is seen to consist of two parts, of which one occupies very nearly the position of the pad of an ordinary truss and is not concave, and the other forms a scrotal portion which is united to the former by a transverse hinge. The scrotal part is a three-sided frame of metal, covered in with chamois leather, curved to adapt itself to the distended scrotum. The apex of the triangle is downwards towards the perinæum, and to it are attached the understraps, which are fastened to the side of the truss just behind the shoulder, as usual. Every pull on the understrap presses the cup against the scrotum, whilst by means of the hinge, the movement is hindered from being conveyed to the pad. This truss is named the "hinged cup." The pressure on the parts in the inguinal canal is obtained from the pad, and that upon the scrotal portion of the rupture from the cup, which is acted upon by the understraps.

Many surgeons recommend that a person with irreducible hernia should keep the horizontal position whilst pressure is being applied, but the instrument, here described, possesses this great advantage, that it enables a man to continue at his work whilst his rupture is under process of treatment. The truss must be taken off at least once a day that the patient may wash himself, but, like the hollow pad truss, it should be immediately readjusted, and worn night and day. Generally after two or three weeks the hernia either returns spontaneously, or can be reduced by taxis, but sometimes a much longer time is needed to effect reduction.

Difference in Results of Treatment in Irreducible Inguinal and Femoral.—There is a well-marked difference in the results of treatment between the hollow pads and the hinged cups. Whether it is that the former does not so completely embrace the rupture as the hinged cup, or that femoral herniæ are in themselves more difficult of reduction than inguinal, it appears that of 130 cases in which the hollow pad was used (68) 52.3 per cent. were reduced, and of 128 in which the hinged cup was used (88) 68.7 per cent. were reduced. Therefore,

under the hollow pad a little more than half the ruptures went back, and under the hinged cup a little more than two-thirds went back.

But not only does a larger proportion of inguinal than of femoral ruptures become reducible, but the reduction of the former is effected on an average in a shorter time. It will be convenient to divide these cases into those in which the rupture went back in less than a year, and those in which more than a year was needed. Many of these patients neglect to visit the surgeon every three or four weeks, as they should do, but continue to wear for long periods these trusses, which are only intended for temporary use, or they omit to wear the truss at night, so that the average time required for reduction is longer than it would be if all the patients were careful and obeyed instructions.

Among 67 cases of femoral hernia treated with the hollow pad, 18 were reduced on an average in 75 days, and 49 were reduced on an average in 3.9 years. Among 85 cases of inguinal hernia treated with the hinged cup, 53 were reduced on an average in 51.8 days, and 32 on an average in 2.8 years. From these statements it is seen that a larger proportion of inguinal than of femoral ruptures is reduced within one year, and that the femoral hernia are longer in going back, whether reduction takes place in some days or in some years. In other words, the effect of the hinged cup is not only greater than that of the hollow pad, but it does its work in a shorter time.

Fluid in the Sac of an Irreducible Hernia.—Fluid is sometimes present in the sac of an irreducible hernia. Among the inguinal cases in Table XXV. it occurred in 13.3 per cent., and among the femoral in 5.2 per cent. When continuous pressure is applied to a hernia, so circumstanced, the first effect noticed is the absorption of the fluid. Reduction of the solid parts follows afterwards. So certain is the disappearance of fluid under the pressure of the hinged cup, that my colleague, Mr. Langton, has for years treated with this instrument the hydroceles of children with complete success.

Pressure on an Enterocele.—We are sometimes warned by surgical writers not to apply instrumental pressure to an enterocele, but this is merely a theoretical precept. No evil results ensue in practice from applying a hollow-pad or hinged-cup truss over intestine.

Horizontal Posture not necessary.—Whether the rupture be large or small, it is never absolutely necessary to put the patient to bed whilst pressure is being made upon it.

Richter and later surgeons have treated irreducible hernia by keeping the patient in bed, giving a sparing diet, and making instrumental pressure on the part. Malgaigne at one time substituted for the latter ice to the part.[4] It appears to be a favourite practice in France at the present day to employ an elastic bandage to make the pressure, and this

method has been successfully used by Mr. John Chiene.[5] The horizontal posture, no doubt, hastens reduction, but it is not necessary, and few patients will submit to it.

Causes of Failure of Reduction.—In the preceding pages it has been shown that a certain proportion of irreducible herniæ can be made reducible, but a residue is left of herniæ which resist treatment. In many such cases the failure depends upon the careless disposition of the patient, but there are still others in which it is due to the nature of the obstacle itself. Adhesions of great toughness, or, as sometimes they are, of cartilaginous hardness, will scarcely yield to such pressure as a truss is able to exert. Patients so situated either continue to use for years a hollow truss, or they neglect the rupture altogether, or they come under the surgeon's knife.

Alternative Measures when Pressure has proved ineffectual.—A person wearing a hollow truss for irreducible hernia cannot be deemed secure, for at any moment a descent of intestine may occur, and he may suffer strangulation. It is probable that this is not of common occurrence among irreducible ruptures, but when it happens, the danger to life is so great that every means should be employed to obviate it by effecting reduction. After giving a fair trial to instrumental treatment, and proving it to be ineffectual, the patient must be recommended to submit to operation rather than continue in his precarious state.

When the hernia is small, or of moderate size, the sac should be opened and the adhesions separated, or the too bulky omentum removed. There are, however, two instances, in one of which this proceeding is not safe, and in the other not very successful.

If the rupture is very large, the surgeon must beware of opening the sac. It has long been known that the fatality of the operation in these cases is very great. The patients are usually fat, flabby persons, past the middle period of life, and are unfavourable subjects for any operation.

In the second instance, the parts are adherent about the neck and mouth of the sac, and the operation is not satisfactory, either because the adhesions must be left undisturbed, or because the abdominal wall must be divided for a considerable distance to permit of their separation. This cutting of the wall of the belly is likely to lead in after times to an uncontrollable rupture.

In cases suitable for operation, the surgeon, after having dealt with the condition which opposes reduction, now generally uses the opportunity to practise one of the various operations for the so-called radical cure of hernia.

REFERENCES TO CHAPTER XXV.

1. **Prengrueber.** Bull. Soc. Chir., 1888, p. 503.
2. **G. Arnaud.**—Mem. de Chir., 1768, ii. 516.
3. **Petit.**—Tr. des Mal. Chir., 1790, ii. 297.
4. **Malgaigne.** Rev. Méd. Chir., 1852, x. 170.
5. **John Chiene.**—Ed. Med. Jour., 1886, vol. xxxi., part ii., p. 803.

CHAPTER XXVI.

ON THE OPERATIVE CURE OF HERNIA.

Historical Retrospect. A large number of operations for the cure of hernia were invented and handed down to us by the surgeons of antiquity, and of the Middle Ages. Why they needed such a multiplicity of methods is not surprising, seeing that not one of these methods was invariably successful or invariably safe. In several of the early operations we find the same principle, and to some extent the same manipulations as are in vogue at the present day.

Ancient Methods of Cure. Celsus exposed by incision and loosened the sac, and appears to have removed it, but his manner of doing so is not exactly known. He spared the testicle. An operation, described with much closer attention to detail, has been preserved in the fragment of Heliodorus.[1] This celebrated surgeon flourished in the reign of Trajan at the beginning of the second century, and what remains of his writings discovers his acuteness and wonderful precision, and begets an exalted idea of the state of surgery at that epoch. It is not necessary to give here more than an outline of his operation.

The direction of the first incision is uncertain. The wound was to be kept open by hooks, whilst the assistant held the testis upwards and to one side. The membrane stretched between the hooks was divided longitudinally and removed, till the peritoneum was reached. The spermatic vessels were isolated. After the bleeding was stopped, the cremaster (*i.e.*, vas deferens) was to be sought for, and was not difficult to find after the vessels (of the cord) had been set free. He next proceeded to isolate the peritoneum. "It is already separated from the vessels, the vas and the tunica vaginalis." The testis was replaced in the scrotum before the removal of the sac. After reposition of the testicle, some casual adhesions of the sac with other structures were divided, and then a careful examination was made, to make sure that no intestine had

slipped down. This was determined by viewing the stretched sac against the light and by the touch.

Before proceeding to resect the sac, he gives minute directions concerning the amount to be taken away. The sac was to be seized at the end and twisted, and then cut off. If bowel descended, the twisting was to be begun at the empty part of the sac, whilst the loops of gut were slowly reduced. If the bowel was adherent to the sac at one spot, the assistant prevented the protrusion of more viscera whilst the surgeon opened the sac just so far as to admit his finger. The adherent piece of sac wall was separated from the sac, and left attached to the intestine, which was then reduced, carrying the portion of sac with it. Whilst the finger was in the wound, the twisting of the sac was begun, and continued as the finger was withdrawn. The sac was then cut off. Heliodorus goes on to treat of the dressing of the wound, the after-treatment and the accidents that may follow the operation.

The practice of Paulus Ægineta, who wrote in the seventh century, differed according as he was dealing with enterocele, which was the name then used for scrotal hernia, or with bubonocele.[2]

For the cure of enterocele he made, after reduction of the parts, a transverse incision in the scrotum, just large enough to allow the testicle to pass out. Then without separating the testis and cord from the sac, he transfixed the latter by a "large-sized needle containing a doubled thread . . . and we pass it through the middle at the extremity of the peritoneum close to the incision; and cutting the double we make four pieces of them, and laying them over one another in the form of the Greek letter X, we bind the peritoneum securely, and again twisting round the pieces we secure it. . . ." A second ligature was placed around the spermatic cord and sac, less than the finger's breadth below the first. A division was made between the two ligatures, and the testis taken away with the lower one. This pernicious practice of removing the testicle was continued quite up to modern times.

For bubonocele Paulus gave a choice of two operations, one derived from the ancient and one from the later surgeons. In the first operation a transverse cut about 3 inches long was made across the tumour in the groin, and layer after layer was divided till the sac was reached. He continues, "and the peritoneum being exposed in the middle where it is raised up to a point, let the knob of a probe be applied, by which the intestines will be pressed deep down. The prominences, then, of the peritoneum formed on each side of the knob of the probe are to be united to one another by sutures, and then we extract the probe, neither cutting the peritoneum nor removing the testicle." In the second operation the actual cautery was used over a triangular area with the base upwards which had been previously marked out when the rupture

was protruding. The destruction of the tissues was not carried deeper than the subcutaneous fat.

Methods of the Mediæval Surgeons. The Arabian surgeons, who followed Paulus implicitly, did not make any important addition to the previous methods of cure, but in the Middle Ages a great many new operations were introduced which have been arranged by Professor Albert in five classes.[3]

1. Castration, which was performed by itinerant rupture-curers, and, as William of Salicetus remarked, by foolish physicians.

2. Laying bare the sac. (*a.*) With subsequent double ligature and transverse division (William of Salicetus, Guido, Rogerius, the four Masters, Jamerius); (*b.*) With simple ligature of sac (quoted by Lanfranc); (*c.*) With suture of the sac by means of a gold thread (Geraldus); (*d.*) With loose ligature of sac, and cauterisation of pubes whilst the sac was lifted (Lanfranc, Petrus de Dya).

3. Inclusion of the sac and scrotum. (*a.*) By needles (quoted by Lanfranc); (*b.*) By a thread passed beneath the sac and tied over a piece of wood (Roger, Alex. Benedictus).

4. Actual cauterisation of all kinds from the exterior and carried down to the pubes.

5. Potential cauterisation (Theoderic John de Crepatis, Andreas in Montpellier, Petrus de Orliato, Guido).[4]

Decadence of Rupture Curing.—Many of these operations appear to have failed in effect, and to have been attended by a heavy mortality. With the advance of surgery and the improvement in the manufacture of trusses they fell more and more into disrepute, till in the last century they were for the most part abandoned to the mountebanks and quacks. Though now and again advocated by legitimate practitioners, operations for cure were generally disapproved and seldom performed, till the discovery of subcutaneous surgery by Stromeyer in 1831.

Revival of Rupture Curing with the Discovery of Subcutaneous Surgery. By the aid of this principle whereby the danger of an operation was infinitely diminished, the art of rupture curing revived. The subcutaneous operations include those in which a solution, more or less irritating, is injected into the hernial sac or into the tissues about it, and all those other mechanical expedients for closing the rings or canal or for obliterating the sac by adhesive inflammation, which can be practised without open wound.

Subcutaneous Operations for Cure — Injection. — A considerable number of surgeons, of whom M. Segond[4] quotes no less than seventeen, have adopted the method of injecting fluids into the sac itself. Schreger used red wine for this purpose, and sometimes air.[5] Velpeau (1837) met with a case of hernia in the tunica vaginalis accompanied by

hydrocele, and intending to cure the hydrocele by the injection of iodine, he found that the hernia disappeared at the same time. This suggested to him the employment of iodine injections for exciting inflammation in the sac of a hernia, and thus for procuring its obliteration. Walther, in 1839, suggested, as an improvement on the method of Belmas, injecting blood into the sac.[6] Morisset substituted in 1842 a solution of oak bark.[7] In 1847, Pancoast used tincture of cantharides.[8] In this country the injection of decoction of oak bark into the hernial sac has been of late years brought into notice by Mr. Keetley.[9] In 1871, Schwalbe injected a solution of alcohol around the sac after reduction of the contents.[10] Dr. George Heaton, in America, performed much the same operation, using a solution of white oak bark.[11] Lubon of Rheims (1880) used a solution of salt. Dr. Warren's operation is much the same as Heaton's. Perez Ortiz combined these two methods, and injected alcohol not only into the sac, but into the surrounding tissues.[12] Of the **subcutaneous operations** strictly so called, the first was that of Gerdy (1835).[13] The scrotum and sac were pushed into the inguinal canal by the index finger, and the end of the invaginated tissues was fixed to the surface of the abdomen by sutures. Gerdy then destroyed with ammonia the scrotal skin lining the invaginated tube, and endeavoured to close the mouth of this tube with sutures. He ultimately abandoned this last part of his operation.

In 1836 Bonnet attempted to set up adhesive inflammation in the hernial sac by acupuncture.[14] Belmas, in 1837, by means of a hollow needle, introduced into the neck of the sac a bladder of goldbeater's skin, for which he afterwards substituted threads of gelatine.[15]

Wütz̈er's Operation.—The operation which has been so well known in this country under the name of Wütz̈er, its principal exponent, was invented by Leroy in 1835.[16] Wütz̈er's earliest operations were done in 1838. The scrotum was invaginated by means of a wooden cylinder. Over this, on the surface of the inguinal canal, a grooved piece of wood or ivory was applied corresponding to the cylinder. From the buried extremity of the cylinder a needle was then projected, which passed through the soft parts and appeared at the surface of the groin through a hole in the wooden cover. The latter was also fastened to the handle of the cylinder by a screw, so that between the two parts of the instrument the invaginated portion of the sac was pressed anteriorly against the front wall of the inguinal canal. After six or seven days the cylinder was withdrawn. This operation was introduced into England by Sir Spencer Wells in 1854.[17] Various modifications have been brought forward from time to time in the details of the original operation, but none of them have sufficed to save it from extinction.

Chisholm (1861) devised a plan of closing subcutaneously the inguinal

ring by silver wire, and leaving the suture *in situ*.[18] Dowell also (1866) performed a subcutaneous suture for the cure of hernia.[19]

A subcutaneous operation was invented by Dr. Reuben Vance, in 1883, "by which the inner ring is converted into a slit, the long axis of which is directed downwards and inwards . . . the anterior and posterior walls of the inguinal canal are brought into apposition, and finally the pillars of the external ring can be transfixed and united."[20] The suture, by which these several purposes are accomplished, is removed at the end of seven days.

Wood's Operation.—There are several operations, not literally subcutaneous, though often reckoned as such, in which a small open wound is an essential feature, and yet the greater part of the proceedings are conducted subcutaneously. Such are the operations of the late Professor Wood and of Mr. Spanton.

Professor Wood made a small incision at the upper part of the scrotum, through which the index finger was passed in order to invaginate the hernial sac into the inguinal canal. By means of an armed needle, guided by the finger in the canal, a somewhat complicated suture was effected of the sac and abdominal wall whereby the following objects were thought to be obtained:—(1.) "The deep ring and hernial opening were closed flush with the peritoneum, while the internal oblique and transversalis muscles and the external oblique aponeurosis were united to each other and to the deep hernial opening and mouth of the sac. . . . (2.) The conjoined tendon . . . was united to Poupart's ligament close upon and over the spermatic cord and twisted sac. Thus the valve action of the canal walls was restored, and the deep ring supported from below. . . . (3.) The pillars of the superficial ring were laced up like a boot, supplementing the weakened arciform fascia, supporting the other adhesions, and forming a third line of defence against a renewal of the protrusion. There was no permanent invagination of fascia after the purposes of the operation itself were fulfilled."[21] When the operation was done with silver wire, it was withdrawn after a week or ten days, but when kangaroo, deer, or ox tendon was used, the suture was left undisturbed.

Mr. Spanton's Operation.—Mr. Spanton, in 1881, invented the following operation. A vertical incision, beginning about 2 inches below the pubic spine, is made in the scrotum, and the sac is exposed. The latter is now freed for some distance around the wound from the superjacent membranes. It is then invaginated into the canal by the index finger, whose palmar surface looks forwards. The instrument, designed by Mr. Spanton, in the form of a corkscrew, is introduced at the upper end of the inguinal canal, and is rotated until it appears at the scrotal wound. In its course downwards the finger protects the cord and other structures

from injury. The instrument at each turn pierces the sac and the margins of the rings or walls of the inguinal canal. It is left *in situ* for eight to fifteen days, and then removed.[22]

The method of Mösner (1846), which consisted in passing a seton along the hernial track and retaining it till suppuration supervened, may be mentioned in this context.[23] It was likewise adopted by the late Dr. Carnochan.[24]

Operations by Open Wound.—The operations which have just been cited under the general heading of subcutaneous operations have not been entirely free from danger, nor by any means constantly satisfactory in their results. The superior advantages of the operations by open wound, whereby the surgeon is enabled to execute every step with precision and to close most effectually the passage, were long since recognised, but were not available on account of the serious risk attending wounds of the peritoneum. When, however, the protection afforded by the aseptic treatment had fully revealed itself, the operations by open wound again became predominant.

The first operation, under aseptic precautions, for reducible rupture in this country is believed to have been performed by Mr. Steele of Bristol, in May 1873. At the meeting of the British Medical Association at Plymouth in 1871, Sir Joseph Lister related two cases, one of traumatic ventral and one of umbilical hernia, which had been irreducible, and had been treated by opening and obliterating the sac.[25] The effect of the aseptic treatment, as applied to curative operations for hernia, has been to diminish so considerably the danger to life, that all those methods can now be employed which involve the laying open of the peritoneal cavity. But the aseptic treatment must not be considered as increasing the efficacy of curative operations, except so far that by its aid more efficacious operations can be undertaken.

The Early Operations.—One of the earliest of the curative operations with open wound was a simple herniotomy (there being no stricture to divide) with scarification of the tendinous rings. This is mentioned by Shacher, in 1721, as an operation of long standing.[26] In order to avoid the danger of opening the peritoneum, some of the old surgeons would separate the sac and place a ligature around it close to the external ring (Lanfranc), or would separate from the spermatic cord only that part of the sac adjacent to the ring and tie it there.* By some the sac was exposed, part of it cut away, and the edges sewn over the cord. This went by the name of the royal stitch. Arnaud and Petit proposed freeing the sac from the cord and scrotum and returning it, as well as its contents, to the abdomen. Schmucker advocated separating the

* Mentioned by Heister, revived by Langenbeck.

sac, tying it high up, and cutting it off below the ligature.[27] This proceeding has enjoyed great popularity.

Czerny's Operation.—All these operations aim at obliterating the hernial sac, but leave the aperture in the abdominal wall untouched. Czerny suggested and practised the obliteration of the sac and simultaneous closure of the canal and outer ring.[28] He published his first cases in 1876. Under strict aseptic precautions he exposed the sac at the neck and separated it from the cord just sufficiently to allow an aneurism needle, carrying a stout catgut, to be passed under it. The hernia, if reducible, was reduced, and the ligature tied. If irreducible, the sac was opened, the adhesions divided, the omentum, if necessary, ligatured, and cut off. Then the hernial sac was tied as high up as possible. The dilated external ring was then closed in the early operations by a continuous suture, in the later ones by interrupted sutures. The thread was passed, not only through the pillars of the external ring, but also through the fibres of the internal oblique and transversalis muscles which cross the neck of the sac. The material used for the stitch was at first catgut, but afterwards silk.

Subsequent operators have used the same method, but have excised the sac below the ligature. This is the operation of Annandale[29] and Mitchell Banks,[30] the latter of whom closes the external ring with silver wire and buries it.

Ball's Method.—A slight modification in this method was introduced by Mr. Charles Ball in 1883, which consisted in twisting the loosened sac before applying the ligature.* [31]

Riesel, in order to reach the sac at its highest level, split up the anterior wall of the canal. In a large hernia, where the internal and external rings have become approximated, this additional incision is needless; but in small herniæ, or in those with a narrow neck, the mouth of the sac can hardly be otherwise arrived at. If a part of the sac is left unclosed above the ligature, the infundibulum or recess there existing is thought to favour the redescent of the viscera; to act as "a trap for a future hernia," as M. Lucas Championnière said.

MacEwen's Operation.—To obviate the effect of this disposition, Dr. MacEwen invented an operation in 1886, and described the main features of his plan in the following words: [32]—

"The sac is carefully separated, not only from the entire inguinal canal, but also from the abdominal aspect of the circumference of the internal ring. It is completely reduced from the canal into the abdomen beyond the internal ring, then thrown into a series of folds, constituting a pad which is placed

* It has been shown that torsion of the sac was used by Heliodorus.

on the peritoneal surface opposite the internal ring. It there constitutes a boss or bulwark with its convexity presenting backwards towards the abdomen, while its base rests on the abdominal wall surrounding the circumference of the internal ring. This not only protects the internal ring, but sheds the intestinal wave backwards away from the opening. . . . The canal having been refreshed by the finger and the handle of the scalpel during the removal of the sac therefrom, its walls are brought into direct contact. . . . The aim being to carry the conjoint tendon outwards towards the fixed unyielding ligament of Poupart, and to unite it with the transversalis and internal oblique muscles."*

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* I append here the details of MacEwen's celebrated operation.

After reduction of the hernia an incision is made sufficient to expose the external abdominal ring. An exploration of the sac and contents is then made, and the finger, introduced into the canal, examines the abdominal aspect of the internal ring and the relative position of the epigastric artery.

The operation consists thereafter of two parts—1st, the pad formation; 2nd, the closure of the canal.

1. *The Pad Formation.* -The fundus of the sac is to be separated from the tissues of the scrotum. The sac is next drawn down, and the finger in the canal is used to separate it from the spermatic cord. Then the finger is passed up to the internal ring, and separates the parietal peritoneum for about half an inch around the abdominal aspect of the circumference of the ring. Now a stitch is secured firmly to the distal extremity of the sac. The end of the thread is then passed in a proximal direction several times through the sac, so that when pulled upon the sac becomes folded like a curtain. The free end of this stitch, threaded on a hernia needle, is made to traverse the canal and to penetrate the anterior abdominal wall about one inch above the internal ring, the wound in the skin being pulled upwards to allow the point of the needle to project through the abdominal muscles without penetrating the skin. After the suture of the canal the stitch is secured by passing it two or three times through the external oblique muscle.

2. *Closure of the Canal.*—Care is taken to avoid the epigastric artery. One finger is placed in the inguinal canal, and a threaded hernia needle (curved) is then introduced, and, guided by the finger, is made to penetrate the conjoined tendon in two places—firstly, from without inwards near its lower border; and secondly, from within outwards as high as possible on the inner aspect of the canal. One thread is drawn from the needle, and the needle itself is withdrawn with the other.

Next, the other hernia needle, which is curved in the opposite sense to the former, is threaded with the lower of the two threads, and is introduced from within outwards through Poupart's ligament and the aponeurotic structures of the transversalis, internal, and external oblique. The needle is then withdrawn.

The needle is now threaded with the thread which protrudes from the upper border of the conjoined tendon, and is introduced from within outwards through the transversalis, internal, and external oblique muscles at a level corresponding with that of the upper stitch in the conjoined tendon. The needle is freed and taken out. The two ends of the thread are now tied tightly in a reef knot. The same stitch may be repeated lower down the canal if thought desirable. The pillars of the external ring are likewise brought together. The dressings are left for fourteen to twenty-one days. The patient is not allowed to rise from bed for four to six weeks after the operation, and not permitted to work till the end of the eighth week, nor to lift heavy weights till the end of three months. He is advised to wear a pad and bandage. But in children and adults not actively employed, no pad is used.

Stanmore Bishop's Operation.—A very ingenious modification of this operation was devised by Mr. Stanmore Bishop (1890).[33] In making the pad from the denuded sac, instead of passing the thread through and through the sac from one side to the other, Mr. Bishop passes it through the wall of the sac on each side, so that, when drawn upon, the sac is thrown into folds not like a curtain, but like a purse. The sac is invaginated into the canal and turned inside out, and when the thread is tightened the sac forms "on the inner aspect of the abdominal wall a Roman arch, which protects the weak space in that wall." There is another important difference between this operation and Dr. MacEwen's, for whereas Mr. Bishop cuts up the anterior wall of the inguinal canal to carry on his manipulations, Dr. MacEwen preserves it and performs a great part of his operation under the aponeurosis of the external oblique.*

Bassini's and Halstead's Operations.—An operation of a somewhat different type was published by Bassini in 1890, but had been performed by him since 1884. The essential feature of the operation is the complete restoration of the posterior wall of the inguinal canal. The spermatic cord is made to traverse the deeper layers of the abdominal wall at a higher level than before, so that it no longer emerges at the old hernial aperture, which can be completely closed. To carry out this operation the aponeurosis of the external oblique over the inguinal canal must be freely divided.[34] An operation closely resembling this in principle was brought before the profession about the same time by Dr. W. S. Halstead.† [35]

M'Burney's Operation.—Dr. M'Burney supposes that a firm cicatrix will be the best protection against relapse, and to "insure the formation of dense cicatricial tissue throughout the whole length and depth of the canal, the wound is carefully packed with some dressing down to the very bottom, that is, down to the transversalis fascia below, and to the peritoneum above."[36] The same idea was conceived and carried out by M. Theophile Anger,[37] in 1887, and by Schede at Hamburg. After ligaturing the sac at the inner ring and excising it below the ligature, the edges of the skin are inverted and sewn to the edges of the deeper tissues to keep the wound patent. The gap is packed throughout with gauze, and thus healing by "the second intention" is obtained. This operation deserves confidence if it can be shown that the scar preserves for a long period of years its firm, unyielding character. The method has been practised in America, and has been termed by Dr. Abbe the best now in vogue, and is esteemed by him as superior to MacEwen's.

* In some cases MacEwen divides the anterior wall of the inguinal canal.

† Among the operations introduced in recent years may be mentioned the "flap-splitting operation" of Dr. B. E. Hadra. (See New York Med. Rec., 1891, vol. xl. p. 620).

It is not, however, admitted on all hands that a cicatrix formed from granulations is the most durable. MM. Terrier[38] and Lucas Championnière[39] are strongly of a contrary opinion, and the latter gives the preference to scars obtained from healing by the first intention. Looking to the changes that time works in all scars by thinning and softening them, even when they have been formed from granulations, it is not improbable that a more extended experience will reveal defects in Dr. M'Burney's operation not at present manifest.

Dr. Niehans' Operation.—A somewhat novel method of strengthening the parts at the inner ring was adopted by Dr. Niehans, and is described by Dr. Zesas. When the inner ring had been sutured, a large layer of the periosteum from a dog's tibia was placed over that area and fixed by stitches. After recovery, a firm, tense tissue was felt to occupy the region of the inner ring which did not yield any impulse on cough.[40]

Operations on Hernia in the Tunica Vaginalis.—All who have practised operations involving the removal of the hernial sac, have met with more or less difficulty when the viscera have occupied the tunica vaginalis. The close adhesion of the spermatic cord to the back of the serous sac makes the separation of these two structures laborious and sometimes impossible. In order to evade the difficulties hence arising, Kraske (1882) suggested that the testis should be removed with the sac, but this proposal, in cases where the testis has reached its normal development, has not met with approval.

When the testis is retained in the canal or just outside it, and is small and very sensitive, many now are in favour of removing it during the operation, and all the more as these imperfect organs are probably sterile. But it is very seldom, as before observed, that a testis, arrested in its development, gives rise to uneasiness or interferes with the use of a truss. Nevertheless surgeons seek to justify the removal of these testes on the grounds that they give rise to suffering, and that an instrument cannot be worn over them. It appears to me very probable that too little attention has been paid to the management of trusses by those who have difficulty in applying them in these cases. Whether the testis is wholly or partly without function, it is an organ that a patient is seldom willing to lose, and it is very doubtful whether its removal aids in any material degree the ultimate result of the operation.

The difficulty of isolating completely the serous sac in hernia of the tunica vaginalis has been met in various ways. Sonnenburg and others excise a part of the sac and leave the peritoneum on the spermatic cord untouched.[41] MacEwen first isolates the sac from its connections in the inguinal canal. He then opens it and divides it transversely into an upper and a lower portion, but this incision stops short of the cord. The lower part of the sac is sutured and forms the tunica vaginalis; the

upper part is pulled down as far as possible, and is split behind longitudinally so as to allow the cord to escape. He then deals in his usual manner with the free part of the sac which is anterior to the longitudinal incision.[42]

Nicaise pointed out that the tunica vaginalis consists of the fibrous sheath of the cord and a peritoneal lining, that the latter is always thin, and generally separable from the outer tunic which conveys the structures of the cord.[43] He admits, however, that the separation of the serous from the fibrous tunic in some cases is impossible.

Richelot *[44] went further than this, and maintained that the serous lining of the tunica vaginalis can always be isolated, and easily isolated, provided the peritoneum alone is dissected. This statement still awaits confirmation.

For those who experience difficulty in separating the sac from the cord in hernia of the tunica vaginalis there is a method which appears to have been suggested by Czerny under the name of "internal suture of the hernial sac," and to have been adopted by Hahn,[45] Nicaise, Julliard, Terrillon, and others. The sac and cord are separated as high up as possible, and the sac, after being opened, is sutured at the inner ring. A number of interrupted sutures are passed through the sac walls at different levels, so that it has the appearance of being quilted. The sutures of course avoid the spermatic cord. Thus the whole of the tunica vaginalis is obliterated from the inner ring downwards. The walls of the canal and the external ring can be afterwards approximated.

The Choice of the Operation.—If there is any difficulty in making choice of an operation, it evidently arises not from a lack of operations, but because not one of the operations commands the universal confidence of the profession. The choice between the subcutaneous and the open operations must be considered as already decided, and there is no necessity to recapitulate the reasons, which are sufficiently obvious, for preferring the methods by open wound.

It is often pleaded by enthusiastic rupture-curers when their cases relapse after operation, that the patient is in a better condition than before, and that his hernia is more easily controlled. This is undoubtedly true, but the patient's state varies in this respect according to the operation which has been performed. I will here adduce the evidence derived from the relapsed cases that have visited the Truss Society from time to time, to show the great superiority of the open wound operations over the subcutaneous in ameliorating the rupture when they have failed to cure it.

* Richelot excepts some cases in which the gut is adherent to the sac.

TABLE XXVII.

Table of Cases upon which operations for the Radical Cure had been done, showing their condition on visiting the Truss Society.

	No Protrusion.	Bubonocele.	Scrotal.	Percentage of Scrotal.
Wütz er's operation . . .	2	9	16	59.2
Wood's operation . . .	...	25	51	67.1
Operations by open wound .	9	33	28	40.0

The most common operations of the subcutaneous class which have been done in this country are Wütz er's and Wood's. Of cases that have relapsed after Wütz er's operation and have come to the Truss Society, 59.2 per cent. were scrotal. In like manner, 46 cases of relapse after operation by the late Professor Wood himself, and 30 by other surgeons (76 in all), have been treated at the Society, and 67.1 per cent. were scrotal; whereas of 70 cases of operation by open wound, by various surgeons, which afterwards required a truss, only 40 per cent. were scrotal (see Table XXVII.). These figures give some indication of the evil plight of those who have not been cured after either of the subcutaneous operations above quoted.

The propriety of opening the Sac in operations for cure is very generally acknowledged, for without doing so it is not always possible to make sure that all the viscera have been reduced. Busch met with a case which emphasises the importance of taking this precaution. When operating on a boy $2\frac{3}{4}$ years of age for right inguinal hernia, he ligatured the sac before opening it. When the sac was incised below the ligature, the appendix vermiformis was found included by it. He released and returned the appendix. Some time afterwards he performed a similar operation on the left side. On opening the sac he found the appendix vermiformis again included in the ligature and adherent to the testis.[46]

Conditions essential in Operations by Open Wound.—As regards, then, the choice of operation, it is advisable to perform one of those with free incision, and in which besides the sac is laid open. It is now generally considered an essential element of success that the sac should be obliterated at its highest point, so that no peritoneal recess may be left as the starting-point of a new hernia. The closure of the walls of the canal and outer ring is frequently but not universally adopted.

The Safety of the Operations.—When it is necessary to choose between the different operations which fulfil the above conditions, the decision is by no means easy. They are all on the same level as regards

danger to life, for they are all under the ægis of the aseptic treatment. The death-rate is now very small, and is probably still diminishing. Richelot quoted 140 cases,[47] and Stanmore Bishop 199, without a death,[48] MacEwen did 52 without a fatality, and Bassini operated on 216 persons with one death.[49] Svensson and Erdmann report 106 cases, which were not selected cases, with only one death.[50] Haidenthaller, in 1890, gave the statistics of 93 cases from Billroth's practice in which the death-rate was 6.7 per cent.[51] At three of the large London hospitals of late years the rate has been 7 per cent.* Perhaps M. Lucas Championnière is right when he says that it is "not an operation for every one; that it is harmless in the hands of a trained surgeon, but disastrous under opposite conditions."[52]

Mr. Mitchell Banks, who has followed M. Championnière in making that useful division of cases into (1) "moderate-sized herniæ, and (2) very large and enormous herniæ," has shown that the danger is very slight in the first class, but very considerable in the second.[53]

The Efficacy of the Operations.—If there is little difference between the operations in respect to their safety, there appears to be equally little in respect to their efficacy. According to the statements of those who very often practise them, and to the experience of most surgeons, they all, as a rule, cure for a certain time. The duration of the cure is quite unknown to us.

Unsatisfactory Nature of the Evidence as to Efficacy.—The evidence, brought forward by one surgeon after another in favour of these operations, is always of the same character. A number of cases are given in which the operation has been performed, and in which the result has been watched for periods varying usually from a few months to four or five years. Very few cases in each series are under observation so long as five years. For the patient changes his residence or declines to show himself. M. Terrier on one occasion wrote to twenty-five old patients, and received only two replies. It must not be supposed that a patient is cured because he does not come for inspection. The relapsed cases at the Truss Society have almost all been asked if they have visited the operator to show him the result. In the great majority of cases they prefer not to go back, and very often, alas, express themselves, as if a deception had been practised upon them. It is much to be regretted that patients should feel this reluctance to face the operator again, for in consequence the surgeon is apt to form too favourable an opinion of the efficacy of his plan. Sometimes a patient, after remaining cured for a number of years, passes from under observation and again becomes ruptured. For these reasons statistics, like those of the late Professor

* St. Thomas's Hosp., from 1884–1889 inclusive; St. Barthol. Hosp., 1885–1890 inclusive; University Coll., 1885–1888 = 157 cases and 11 deaths.

Wood, are quite misleading where many cases are entered as cures which have since relapsed.

All that we are able to say of the operations, involving complete removal of the sac, is that they all give immunity to a certain number for a certain time. We have not the means of distinguishing between the merits of the different operations in regard to the frequency and durability of the cure; and therefore, beyond the conditions already laid down for the operation, the surgeon's choice must be determined, in the absence of facts wherewith to guide it, by inference or prepossession.

Division of the Aponeurosis of the External Oblique.—Before leaving the subject of the choice of operation it may not be unprofitable to consider whether the division of the aponeurosis of the external oblique is advisable. The majority of operators preserve the tendon intact. The justification for dividing it is that thereby the highest point of the neck of the sac can be reached, and no peritoneal recess is left to form a future rupture. On the other hand, the power of the inguinal canal to recover itself, when the viscera are kept for a time reduced, is well recognised, and it is open to question whether the wall of the canal formed of normal tissue is not more resistant than one traversed by a scar. Again, after the operation for strangulation, where it has been necessary to cut up the aponeurosis of the external oblique, I have observed that the abdominal wall at that part is generally weak and disposed to bulge, which is not, as a rule, the case when the aponeurosis has been spared.

Operation on Femoral Hernia.—In regard to femoral hernia, all the operations which are limited to extirpating the sac can be performed upon it, but the closure of the femoral ring can hardly be made effectually on account of the proximity of the femoral vein.

The Indications for the Operation.—Among the indications for the cure of hernia are two, which give rise to no controversy, and may be at once disposed of. In irreducible ruptures, when other means have failed to return the parts, an operation is now generally recommended, and most surgeons combine with the proceedings for liberating the viscera an operation for closing the abdominal opening. The cases in which it is dangerous or especially difficult to interpose are noticed at the end of the last chapter. During herniotomy for strangulation, after reduction of the parts, a curative operation is now the rule. Those cases, however, must be excepted (1) in which gangrene has occurred, and it is not prudent to close the abdomen; (2) or in which, though the bowel is put back, there is doubt as to its integrity; (3) or in which the patient is in a condition so prostrate, that it would add to his danger to prolong the operation.

Whatever divergence of opinion there may be as to the kind of cases which call for an operation, there is none in regard to the unfitness of

aged and cachectic individuals. Albuminuria, diabetes, advanced tuberculosis, &c., disqualify for curative operations.

Little children also are by many surgeons considered exempt, because their ruptures improve so readily under the use of a truss. No doubt a little patience is sometimes needed to get them into order. Uncontrollable ruptures in children under fifteen are very rare; to me, indeed, they are as yet unknown. I hope it does not imply any lack of charity to say that one can measure with fair accuracy a surgeon's skill in the management of trusses by the number of curative operations he performs on children.

Hernia in the tunica vaginalis, with ectopia testis, is very often included among the cases requiring operation. It has already been remarked that the ectopia does not generally give rise to trouble. Among the 468 persons referred to in Chap. VI., with misplaced testis, not one was incommoded by the application of a truss.

Uncontrollable ruptures of adult life, or incoercible ruptures as the French call them, are commonly deemed suitable for operation, and in such cases curative procedures are of great value. A patient sometimes suffers very much from the slipping of the rupture below the truss; he may have others dependent on him, and be compelled to work, but can only work in misery. He has to choose between an operation or going on, as best he may, till his truss gradually improves, and at length controls his rupture. Some of these patients prefer the operation, yet, strange to say, many more prefer the slower process.

The herniæ most difficult to control are those of persons in broken health, and it is just in these that the dangers of the operation may deter us.

Operation on Hernia easily controlled. In the cases hitherto cited as suitable for operation the hernia has been a grave incommodity, but now it is needful to inquire, if the operation is permissible in those whose herniæ are easily controlled by a truss, and who suffer no inconvenience beyond the presence of the instrument. We are occasionally solicited by a young man ardently desirous of serving his country in the army or navy to deliver him from a rupture. The danger to life in a youth with good health is so inconsiderable that it may be neglected, and few surgeons would refuse to satisfy such a request. But in other cases, where it is not incumbent upon the patient to be without blemish, and when by the aid of a truss he can do all that other men can do, the propriety of operating is more doubtful. If surgeons were divided into those who regard the operation as admissible only when the rupture is a serious incommodity, and into those who regard all ruptures as fair subjects for operation, about two-thirds would be found in the first category, and one-third in the second. This difference of opinion pro-

bably depends in great measure on the view which the surgeon takes of the result of the operation. If he believes that his operation will effect a radical cure and release the patient from a truss for the future, it is not surprising that he recommends it to the ruptured generally.

But the majority of surgeons, with the evidence as yet available before them, are not able to assure the patient beforehand of a permanent radical cure. If the patient wears a truss after the operation, he may be fairly certain of having no more trouble with his rupture. Undoubtedly many persons remain sound after operation for long periods without a truss, but relapses are frequent enough, and, as I have pointed out, they are not always made known to the operator. It must be very difficult, therefore, when in treaty with the individual patient, to deal honestly with him and to promise him a radical cure. Moreover, the surgeon cannot forget, when promising his patient a radical cure, that a person ruptured on one side is likely to be afterwards ruptured on the other. Among single inguinal herniæ in males, 36.1 per cent. become double (see Table I.), so that, if one inguinal hernia is cured, the chance is greater than 1 to 3 that the other side will be ultimately affected, and that the patient must again have recourse to a truss.

Use of a Truss after Operation.—Surgeons differ also in their treatment of the cases after operation. Some wholly reject a truss; many use it; others, who dislike the name of truss, use some substitute for it which supports a pad.* The majority apply some artificial support after operation.

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* Of 27 surgeons who have practised curative operations, 13 use a truss afterwards; 2 use a pad; 5 sometimes use a truss and sometimes not; 7 use no truss.

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14. **Bonnet.**—Bull. gén. de Therapeutique, May 1836, Lawrence, op. cit., p. 127.
15. **Belmas.**—Gaz. Méd. de Paris, 1837, p. 651, quoted by Segond.
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CHAPTER XXVII.

ON CONGENITAL UMBILICAL HERNIA.

Umbilical Hernia develops before or after the fall of the Umbilical Cord.—In infants, the herniæ which appear at the umbilicus are of two kinds, and may be distinguished as those which form before and those which form after the fall of the umbilical cord.

Congenital Umbilical Hernia.—The first are truly congenital, and take origin at an early period of intra-uterine life. They are variously named Congenital Umbilical Hernia, Omphalocele Congenitalis, Hernia Funiculi Umbilicalis, Ectopia Viscerum. Under normal circumstances the intestines up to the end of the second month of fœtal life are outside the abdomen, but at the beginning of the third month, when the omphalo-enteric duct withers and separates, the viscera appear to recede, and the abdominal wall closes over them. If these changes in the position of the intestine do not take place at the usual time or to the full extent, the child is born with a congenital umbilical hernia. This is not a hernia in the ordinary acceptation of the term, for the contents of the sac, as Malgaigne observed, have never been within the abdominal cavity ;* but, in accordance with long standing custom, it will be described here along with the true umbilical hernia.

The Three Divisions of Congenital Umbilical Hernia.—For the purposes of this work the congenital umbilical herniæ may be considered under three classes :—

1. When the gap in the abdominal wall is small ; herniæ of the root of the cord.

2. When the gap is of moderate size ; sacculated herniæ.

3. When the deficiency of the abdominal wall is very great ; eventrations.

First Form—Hernia of the Root of the Cord.—In its simplest form it presents itself as a mere thickening of the umbilical cord at its attachment to the belly. This part of the cord is then lined by a diverticulum of the parietal peritoneum which contains a loop of gut, or, it may be, only a Meckel's diverticulum. There have been cases, which were described by Dupuytren and others, where the enlargement at the root

* "Here the hernia does not deserve the name, for we are not concerned with viscera escaped from a cavity, but with viscera which have never entered it." Ruysch remarked on this hernia, which had been called hernia umbilicalis, that "no hernia can be called umbilical before the umbilicus exists."[1]

of the cord was so insignificant that the midwife placed the ligature around it, and thus occluded a loop of intestine.[2] In like manner a Meckel's diverticulum has been divided and a fæcal fistula formed.*

Second Form—Sacculated Herniæ.—When the defect of the abdominal wall is greater than that just described, the coverings of the herniated parts are still of the same nature. Around the edge of the opening the skin is slightly raised and passes abruptly into the amniotic layer, which, together with the peritoneum, forms the investment of the sac. Between these principal layers is found some scanty connective tissue or even a membrane of considerable density, containing aponeurotic fibres, the "textus tendinosus" of Sœmmering, which is derived from the imperfect linea alba and adjacent muscles. On account of the thinness and translucency of their coverings the viscera can generally be seen through the wall of the sac. The dimensions of the swelling are sometimes considerably increased by a collection of serum between the layers of the sac wall. Cruvelhier has a coloured plate showing this condition. The umbilical cord enters the hernia generally at its summit or in the middle line below the most prominent part; frequently to the left, and very rarely to the right of the middle line.† The vessels travel for a greater or less distance, according to the point of insertion of the cord, between the membranes of the sac before entering the abdominal opening. The umbilical vein is often placed to one side of the mid-line, most frequently to the left. In Julliard's case its course to the liver was so short that if reduction had been attempted without opening the sac, the vein must have been ruptured.[3] The arteries not uncommonly deviate from the normal position, and may both run on one and the same side, usually the left. There may be a single artery, though this is also met with when no malformation is present. Ahlfeld in 8 cases found a single artery 5 times, and he quotes Otto, who had 4 cases out of 11 with a single artery.[4] In the cases where the defect was not so extreme as to make life impossible, the size of the sac varied from that of a walnut to that of a child's head. In rare cases the dimensions were even greater. Among 43 instances the tumour was most commonly about the size of a cricket ball. Its shape is not always uniform, but may be quite irregular. The outline is, however, generally rounded, though constricted more or less at the base of attachment; and this constriction may be so considerable that the sac hangs from a slender pedicle even when all the viscera are contained in it.

* It does not come within the scope of this work to describe those cases in which Meckel's diverticulum remains patent at the umbilicus, and becomes inverted and may be accompanied by prolapse of the bowel (see Barth. Arch. f. Clin. Chir., 1887, vol. xxvi. p. 193).

† In 36 cases where the position of the cord was noted 18 entered in the middle line, 13 to the left, 5 to the right.

In the majority of cases it is some part of the intestine that forms the contents of the sac; sometimes a part of the liver accompanies the intestine, and in about an equal number of cases the liver alone is protruded.* The very large herniæ contain, in addition, the spleen, the stomach and omentum. Dr. Jacobus found also the left kidney and a part of the uterus in the sac.[5] It follows, of necessity, that when the intestines are so far from their natural position, the mesentery must be longer than ordinary. This condition is so constantly met with that it appears to have suggested to Thudichum to attribute the cause of these malformations to a redundant mesentery.[6] The attachments of the liver are not materially altered when only a small part of the organ is external, but when nearly the whole liver is in the sac, though the suspensory ligaments remain, the coronary ligaments are wanting. The diaphragm in the latter instance is low, and may have its convexity downwards, or it may be defective, and the heart may occupy the base of the sac.

The different shapes which the liver takes in these herniæ are easily conceived, if we assume that the walls of the belly close up around it before the whole has retreated within that cavity. The organ thus becomes divided into two parts connected by a constricted portion which passes through the opening in the abdominal wall. The external part, therefore, may be a mere tongue of the liver proceeding from the lower edge, or it may be the anterior part of the organ or a whole lobe. In a case described by J. G. Schäffer, the sac contained almost the whole organ, which was nearly spherical in form, whilst a small pear-shaped part was left within the belly.[7] Berthelot found only the Spigelian lobe within the abdomen.[8] But there are still cases where the whole organ is outside the abdominal wall. This had happened in a child, born at term, dissected by Marriques, whose description gives such an excellent idea of these cases that I will quote it at length.[9]

"In the lower part of the epigastric region was a large hernial pocket which floated from side to side on the belly wall. This was possible because it was constricted at its junction with the belly, where the pedicle measured 1 inch across. The tumour had very thin walls formed of peritoneum and epidermis. It was exactly round, 14 inches in circumference. The umbilical cord was attached at the lower part of the front of the sac. The vessels passed between the layers of the sac wall upwards. The umbilical vein at the upper part of the sac dipped to enter the liver, crossing behind the umbilical artery, still between the layers of the sac wall. The arteries proceeded upwards and then backwards to reach the aperture in the abdomen, and then descended to the pelvis. The sac contained the liver, spleen, stomach, pancreas, much mesentery, and all

* In 47 cases, the intestine alone was in the sac 28 times, the intestine and liver 9 times, the liver alone 10 times.

the intestines. The liver was at the right upper part, not connected as usual with the diaphragm. The spleen was at the left upper part; the cæcum at the right lower part. The colon ascended, and crossed to the left and descended in a curved course on account of the shape of the tumour and entered the belly to reach the pelvis. The urachus ended at the lower edge of the umbilical opening, which was a large inch in diameter. The abdominal wall and skin came up to the edge of the opening. Through it passed the vessels above-mentioned, the mesentery, the lower end of the œsophagus, and the descending colon. The diaphragm was convex towards the abdomen." This is by no means a solitary instance in which so large a hernia has escaped by so small an opening.

Eventrations.—When the gap in the abdominal wall is very great, the condition is termed eventration or ectopia viscerum. In the higher grades of the anomaly nearly all the muscular and tendinous parts of the abdominal wall may be absent, and the cavity be covered in by the fœtal membranes. The umbilical cord is usually short, but it may be of natural length. In other cases the umbilical cord is wanting, and the placenta is applied to and forms part of the wall of the belly, which is closed in the rest of its extent by the membranes.[10] The sac is apt to be rent in these cases either whilst the child is in utero, when the viscera float free in the amniotic fluid, or during parturition.

The eventrations are often, if not generally, accompanied by a flexion of the spinal column, so that the head and buttocks come into proximity. As the defect in the abdominal wall is not generally exactly central, but more tissue, as a rule, is absent on one side of the middle line than on the other, so the convexity of the bend in the spine is directed towards the part where the deficiency is greatest. When the defect in the abdomen is on one side of the middle line, the flexion of the spine is altogether lateral. When the defect involves parts on both sides of the mid-line, but more on one side than the other, the flexion of the spine is intermediate between retroflexion and lateral flexion. It is much to be regretted that the condition of the spine is so seldom noted by authors in their records of congenital umbilical hernia. Among the cases which form the second of the classes into which I have divided the subject, I have not found it stated that the spine was flexed even when all the viscera were outside the abdomen in the sac.

If it were safe to assume that where no mention is made of flexion, no flexion of the spine was present, it would appear probable that the flexion is related to the size of the gap in the abdominal wall. Dr. Dakin has pointed out that flexion of the spine is not necessarily associated with the position of the viscera. The original cause of the flexion of the column and of the accompanying defects in the anterior part of

the body has been traced by the latter writer by means of a very able argument to an arrest in the development of the hind gut.[11]

I may here briefly refer to those rare cases of umbilical hernia which accompany extroversion of the bladder. These herniæ also appear to be commonly associated with defects in the development of the great intestine.

Congenital Umbilical Hernia with other Defects.—It has already been mentioned incidentally that other defects frequently accompany the eventrations, and these defects not only befall the abdominal organs and spine (spina bifida, &c.), but all parts of the body. In some of the umbilical herniæ of less severity than the ectopias, malformations of the intestine or of other parts are also present, but in a large number of cases there is no imperfection of the bowel or of any other part of the body besides that involved in the hernia.

Position of the Aperture of Exit.—In congenital umbilical hernia the opening in the abdominal wall is usually, as the name implies, in the region of the umbilicus. It may, however, be altogether to one side of the middle line, as in the cases of Elsholz,[12] Amyand,[13] Jacobus,[14] Eastwood,[15] and Escalier.[16] Hoin mentions a case, shown to him by Poinsotte of Dijon, of a new-born child at term which had an oblique opening in the right side of the abdomen, extending from the cartilage of the tenth rib to about half-an-inch below the insertion of umbilical cord.[17] The sac contained the liver and all the intestines.

The Size of the Opening varies within wide limits if the whole series of these cases is considered, as it ranges from a complete absence of the front of the abdomen to an aperture not more than half-an-inch across.* In 13 cases, where the fact is noted, the opening in 10 of them was between 1 and 3 inches in diameter.

Cause.—The statement of the earlier writers that the abdominal muscles are deficient to a greater or less extent in these cases (Ruysch, Richter, Scarpa) has been contradicted by later authors, who hold that the recti are merely displaced. Cruvelhier maintained that there is no loss of substance of the abdominal walls.[18] Ribke gives a plate showing the divergence of the recti.[19] Otto Schmidt says he examined four cases, and found no defect in the muscles. This difference of opinion has probably arisen from the observation of different types of cases. In the more common forms where the opening is from 1 to 3 inches across, the defect may be limited to the linea alba, and may not concern the adjacent muscles. Very few observers, however, appear to have actually dissected the abdominal wall. M. Barié, who did so in a case

* In Amyand's case the aperture was on the right of the umbilicus, and about half-an-inch in diameter. The prolapsed parts were a part of the stomach and part of the gall bladder, and all the intestines except the duodenum and rectum.

which contained a part of the liver only, found that the oblique muscles could be isolated by dissection, but that it was impossible to define the recti owing to the thinness of the abdominal wall. In cases where the gap is to one side of the middle line, it can hardly be possible that the muscles are perfectly developed.

Whilst inquiring into the cause of congenital umbilical hernia, it will be convenient to set aside the eventrations which have already been sufficiently considered.

At an early period of fœtal life the external position of the bowel is a physiological condition. It is not at once apparent by what means the intestines are caused to enter the abdominal cavity, whether by the abdominal walls growing over them they are compelled to come in, or whether they are retracted, as is sometimes said, whilst the growth of the wall of the belly is coincident.

The Protrusion of Parts not Normally External in Fœtal Life.—In these herniæ parts are found, which are, at no period, external in the normal course of development. In some cases like that of Marriques the whole stomach, the liver, spleen, and descending colon are in the sac. This prolapse of so much more than ordinarily takes place in fœtal life suggests that some force is exercised to push or drag out the viscera. And, moreover, not only is the mesentery longer than usual, but a rent has been found in it, not recent, as if caused during delivery, but of old date with cicatrised edges.[20]

Cruvelhier's Explanation.—Cruvelhier held that the protrusion is due to compression endured by the fœtus, or by a vicious position of it in the womb. He cited, as a proof, a specimen in the Dupuytren collection, in which an eventration is accompanied by a lateral flexion of the spine.[21] It has since been shown that the distortion of the spine is rather an effect than a cause of the anterior deformity.

Geoffroy St. Hilaire's Explanation.—According to Dubois, Geoffroy St. Hilaire was of opinion that the organs are kept outside by accidental bands, and that thus the abdominal opening is unable to close.[22] An adhesion of one kind or another is found very frequently, but still a considerable number of cases possess no adhesions whatever between the sac and the contents. It is partly for this reason that Ahlfeld's theory appears so defective, for he imagines that the intestines are kept out or drawn out by the persistent omphalo-enteric duct.

Ahlfeld's Theory.—In the majority of cases, he says, the continuous pull, which is exercised by the omphalo-enteric duct on the intestines in the root of the umbilical cord, is the cause of these ruptures.[23] But is not this continuous pull purely conjectural? It has not been demonstrated that the resistance of the intestines is less than the force of the imaginary pull of this ordinarily feeble structure.

In some cases the remains of the vitelline duct, more or less complete, are found attaching the intestine to the root of the umbilical cord; in others, slender bands pass from the same part of the sac to the mesentery and probably represent the obliterated omphalo-meseraic arteries. Again, in other cases adhesions of pathological formation connect the viscera with the sac. As regards the persistence of the fœtal structures, may not this be as much the result as the cause of the imperfect closure of the abdominal wall? It is difficult to determine the date of the pathological adhesions. If they are instrumental in causing or keeping up the rupture, they must be formed very early in fœtal life. On the other hand, adhesions are very common in all ruptures without taking part in producing them.

Mode of Closure of the Linea Alba.—It must not be forgotten that many of the congenital umbilical herniæ exist without any other defect of conformation and without any adhesions of the contents to the sac. In these cases nothing but the defect in the abdominal wall offers itself to explain the condition. If the closure of the abdomen is delayed, the viscera continue to grow externally in the direction of least resistance. The linea alba appears to close first from the pubes to the umbilicus, and afterwards from the ensiform cartilage downwards, the umbilicus being the last to close. Were the whole space from the umbilicus to the sternum open after the ordinary time of closing, and we know that it may remain open and that the fissure may even involve the whole sternum itself,[24] the stomach as it continued to grow would find nothing to prevent its escape. In like manner the liver and spleen might be developed outside the abdominal walls. When the linea alba began to close downwards the opening would be gradually diminished, and, judging from the grooves found upon the liver, the organs in certain cases must be subjected at some time or other to considerable pressure. The old view that these herniæ arise from an arrest of development, or, as it would seem, partly from arrest and partly from delayed development of the abdominal wall, is further supported by the occurrence of unilateral herniæ. The modern theories hardly suffice to explain these cases.

Frequency of Occurrence.—The frequency of congenital umbilical hernia has been estimated by Lindfors from the statistics of the Lying-in Hospital at Munich, which comprise nearly 21,000 births, at 1 in 5184 children.[25]

Diagnosis.—It seems hardly possible that any difficulty could be found in the diagnosis of this rupture. The only condition that might at first sight be mistaken for it is the so-called hydrocele of the umbilical cord. Doughty described a case of the kind in which a transparent sac, 3 inches in length, hung from the root of the cord.[26] It was attached to

the margin of the umbilicus and to one side of the cord for a distance of 1 inch, and therefore the whole circumference of the umbilicus and cord was not involved in the attachment. The sac contained 2 ounces of a straw-coloured fluid, and had no communication with the abdomen. These cases are of very exceptional occurrence.

Mode of Death.—The children with eventrations are often not viable on account of other defects, or the sac bursts before or during delivery. These infants, as Ruysch said, are carried from the womb to the grave.

In cases of sacculated umbilical hernia the child sometimes survives when an expectant treatment is adopted, but more commonly dies. The amniotic covering of the sac first becomes opaque, wrinkled, and dry. At its junction with the skin it begins to separate, and at length the whole membrane is loosened and cast off, leaving a granulating surface (peritoneum) which in favourable cases cicatrises. But when things go ill, as the amniotic covering withers, the peritoneum inflames, and the peritonitis becomes general, or the whole sac wall perishes by gangrene. Occasionally the sac bursts after birth. Sometimes death occurs with symptoms of strangulation.

Treatment.—The treatment of congenital umbilical hernia has been principally of three kinds :—

1. The expectant treatment.

2. Treatment by ligature of sac at its base after reduction of the contents.

3. Treatment by laparotomy ; reduction after opening the sac, freshening the edges of the opening and uniting them with sutures.

Dr. Lindfors, and after him Dr. Willis Macdonald,[27] have investigated the comparative merits of these plans of treatment, and both authors concur in recommending the last. Dr. Macdonald gives 12 cases treated by compress and bandage, of which 9 died ; and 19 treated by laparotomy, of which 2 died. Some authors would limit the operation to irreducible hernia, or to those accompanied by symptoms of strangulation, but the danger of leaving the sac in contact with the fœtid outer covering appears to justify Lindfors' recommendation that the treatment by laparotomy should be preferred to every other.

It happens now and then that the space within the belly is so limited that when the viscera are reduced the child shows signs of suffocation. There is no option in such cases but to adopt an expectant treatment. According to Thudichum, the liver, when external, is always irreducible, and an operation is required to release it. Sometimes the adhesions of the viscera are so close that it is necessary to cut around the adherent peritoneum and return it, still attached, together with the protruded part.

Olshausen removed the amniotic layer of the sac wall and closed the edges of the opening over the unopened peritoneum.[28] Macdonald recommends dissecting away the amnion and Whartonian jelly before opening the sac.

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CHAPTER XXVIII.

ON THE UMBILICAL HERNIA WHICH FORMS AFTER THE FALL OF THE UMBILICAL CORD.

The herniæ which form at the navel after the fall of the umbilical cord during the first year of life do not, as a rule, protrude for some weeks or some months after birth.

Prevalence at Different Periods of Life.—They occur with equal frequency in the two sexes up to ten years of age, thus presenting a striking contrast to the inguinal herniæ during the same period (Table XXVIII.).

Between the ages of ten and twenty years these ruptures may be said not to develop among males and to develop extremely seldom among females, and this slight difference is probably explained by some girls becoming mothers before the age of twenty. Not only do umbilical herniæ not form between ten and twenty, as a rule, but those which arise in earlier years become cured before puberty is reached, so that an umbilical hernia in the second decade is very rarely encountered. In women these herniæ attain their greatest frequency during the child-bearing period, and are more numerous between thirty-five and fifty than before. In men the rupture is somewhat rare at every period of life, and does not show after fifty the marked decline which is noticed among women.

The distension of the abdominal wall in the one sex by obesity, and in the other by obesity and pregnancy as well, sufficiently accounts for the origin of the rupture, and for the difference in the liability of the two sexes.*

Relative Frequency in the Sexes.—According to Table XXVIII., 73 per cent. of umbilical herniæ are in females, and 26.9 in males, or the female cases are to the male as 2.7 to 1.

In regard to the incidence of inguinal, femoral, and umbilical hernia, it is evident that the latter is the least common in both sexes † (compare

* The great enlargement which the linea alba undergoes in pregnancy is well exemplified by an autopsy made by Cruveilhier on a woman who died soon after child-birth. He found the linea alba 8 centimetres wide at the umbilicus, and 3 centimetres at its narrowest part.

† Sir Astley Cooper, however, rates umbilical as next to inguinal in frequency. On Her., 2nd ed., Part II. p. 29, 1827.

TABLE XXVIII.

Cases of Umbilical Hernia, Male and Female, seen at the Truss Society in the years 1888, 1889, 1890, *entered according to the Age of the Patient at the first appearance of the Rupture.*

	Total.	Under 1	1–5	6 10	11–15	16 20	21–25	26–30	31–35	36–40	41–45	46 50	51–55	56–60	61–65	66–70	71–75	76 80
Males . . .	209	108	13	2	...	...	2	5	9	13	12	11	14	10	5	3	2	...
Females . . .	566	100	22	6	2	5	17	52	61	82	63	75	33	25	15	6	1	1
Total . .	775	208	35	8	2	5	19	57	70	95	75	86	47	35	20	9	3	1

TABLE XXIX.

Contains the same Cases as Table XXVIII., *entered according to the Age of the Patient at the time of his or her visit to the Society.*

	Total.	Under 1	1–5	6 10	11–15	16–20	21–25	26–30	31–35	36–40	41 45	46 50	51–55	56 60	61–65	66–70	71–75	76–80	81–85
Males . .	209	82	35	5	...	...	3	4	5	13	10	9	10	14	10	3	4	2	...
Females . .	566	58	55	9	...	2	3	15	18	70	91	81	53	41	36	24	6	3	1
Total .	775	140	90	14	...	2	6	19	23	83	101	90	63	55	46	27	10	5	1

Tables I., II., and XXVIII.), but has a much higher proportion to the other ruptures in females than in males, thus:—

	Percentage of Inguinal.	Femoral.	Umbilical.
Males	90.33	2.53	1.14
Females	50.5	33.5	15.8

Structure of the Linea Alba and Umbilical Ring. The opening in the linea alba, through which the fœtal vessels pass, is filled by firm fibrous tissue to which the skin is adherent on one side and the obliterated vessels on the other. The strange belief entertained by some of the celebrated surgeons in the last century that the hernia does not protrude at the umbilicus, but by an opening alongside of it, was occasioned, as Sir Astley Cooper supposed, by their finding the scar of the navel on one side of the protuberance and not generally in the centre of it. The close connection of the scar to the lower margin of the opening and to the vessels prevents it from yielding as readily as the adjacent skin. Moreover, it is not very uncommon to find a hernia in the linea alba a few lines above the umbilicus, and these may also have favoured the misconception.

The linea alba above the umbilicus is 2 to 3 centimetres wide. It enlarges as the navel is approached, but diminishes again below that point, so that, at a distance of 2 centimetres, it is a mere raphe which descends to the pubes. The linea alba is formed by the interlacing of the tendinous fibres derived from the oblique and transverse muscles. The fibres of one side intercross with those of the other at more or less acute angles, and sometimes leave small elliptical gaps between them, of which the umbilicus is the largest and the most constant. Viewed from the deep side, this opening is seen to be bounded by an upper and a lower arch of fibres. The lower border is weaker and not so well defined as the upper border. The obliterated urachus and hypogastric arteries blend with the lower border so closely that they can hardly be dissevered. The upper edge of the aperture is compact, smooth, and well defined. The umbilical vein has not that close attachment to it which the arteries have to the lower edge, but is connected with it by loose connective tissue. According to Richet, a little mass of fat intervenes between the vein and edge of the ring.[1] The same author describes on the deep surface of the linea alba a groove or gutter for the umbilical vein, which, beginning 3 to 4 centimetres above the ring, terminates at the upper free border. The vein lies in the groove and is covered by the trans-

versalis fascia, the "umbilical fascia" of Richet, which thus completes a canal for the vessel.

Mode of Exit.—Surgeons are now generally agreed that an umbilical hernia comes through the opening in the linea alba which gave passage to the fœtal vessels, but the mode in which the hernia approaches that opening has been explained in different ways. Richet described the umbilical fascia as blending on each side with the sheath of the rectus, and terminating in a sharp, concave border above, and just below the level of the navel inferiorly. He supposed that in children the hernia protrudes directly through the umbilical ring, but that in adults the peritoneum (sac) passes behind the upper concave border of the umbilical fascia, descends the canal with the vein, and emerges at the navel. Thus umbilical, like inguinal, hernia would possess two forms, the direct and the indirect or oblique. This view, according to Sachs, has obtained general acceptance in Germany. Others, on the contrary, have regarded the umbilical fascia as serving to strengthen the abdominal wall, and aiding to prevent the occurrence of hernia.

The subject of the relation of the umbilical fascia to the formation of hernia has been minutely investigated by H. Sachs, by means of more than 200 dissections, and I am indebted to his valuable work for the substance of the following observations.[2] In regard to the upper limit of the umbilical fascia, Sachs found, only exceptionally, a trace of the concave edge described by Richet. The peritoneal diverticula in this situation, he thinks, are formed artificially. When the vein is separated from the liver, it tends to retract a little towards the umbilicus, and the overlying peritoneum connected with it would thus be thrown into a fold at a resisting part of the fascia.[3] Sachs concludes that a hernia at the navel always protrudes directly and not obliquely.

In different individuals the fascia umbilicalis is very unequally developed. In those less than a month old the navel ring is so completely closed by the vessels that it is immaterial whether or not the fascia is present, so far as the production of hernia is concerned. After the first month of life, when the vessels retract and dwindle, the presence or absence of the fascia opposite the navel is of more importance.

The ordinary disposition of the fascia umbilicalis after the first month of life is as follows:—It may occur (1) as a broad fibrous lamella, most strongly developed behind the umbilicus and gradually disappearing above and below that point without any defined border. The peritoneum is closely applied to the fascia and cannot be made to slide on it, and passes without fold or pucker over the umbilical opening. (2) The lower edge of the fascia may present a sharp, slightly prominent border with the concavity downwards. When the fascia extends below the navel, that opening is still perfectly protected, but when the concave

border is over the umbilical ring the case is different. Sachs saw two instances in which the edge of fascia was so placed that the upper half of the ring was covered, and in both these a peritoneal pouch had passed through the ring. In another case the edge of the fascia was just below the ring, and yet a serous diverticulum had passed between the fascia and linea alba through the navel. Sachs points out that the peritoneum in contact with the umbilical fascia is not movable upon it, but that on the linea alba below is freely movable, and from this the serous pouches are derived. (3) The fascia may end with a sharp edge, concave downwards above the navel from .5 to 2.5 centimetres from it. The ring is then without protection, except for the remains of the obliterated vessels. In these cases there is frequently a peritoneal diverticulum through the ring. When the fascia is not disposed in one of the above modes, it may present, in rare cases, gaps, or may consist of separate sections.

In 115 children, from two to eleven months old, Sachs found the umbilical fascia wanting in 30. It was clearly made out in 85. The peritoneal diverticula, before mentioned, which are found occasionally in the umbilical ring, were regarded by Malgaigne and Klebs as of congenital origin, but Sachs considers that they are formed after the first month of life. He did not find one in any child younger than six weeks, and he met with them only in cases where the fascia umbilicalis was defective opposite the umbilicus in the various ways above described.[1] But the principal circumstance affecting the formation of umbilical hernia must be not so much the fascia as the condition of the opening in the linea alba. Hernia at the navel in children will occur according as the ring in the linea alba has been normally or imperfectly closed. In adults it is probable that the ring is stretched until it permits the escape of the viscera. This ring, when freed from the tissue which closes it, is large enough in the adult, according to Sir Astley Cooper, to admit a goose-quill.

Coverings of the Hernia. When a hernia comes forward through the navel, it carries before it the peritoneum and subserous tissue, and is covered by the skin, superficial and deep fascia. Thus very little intervenes between the viscera and the surface. In large herniæ the coverings may be extremely attenuated, and the sac and skin may become so closely adherent as to be inseparable. Many of the old surgeons believed that umbilical herniæ had no peritoneal lining, and this, no doubt, arose from the thinness and close adhesion of the coverings so often observed in old ruptures. Sir Astley Cooper has given a drawing of a dissection showing a large hernia in which the serous layer has become so thin in three places that it appears to have given way, and permitted the omentum to escape into the tissues surrounding the sac.*

* Sharp makes a similar observation. (Inquiry, &c., p. 51.)

The contents of these herniæ consist of the intestines in children and of the omentum and intestines in adults. The colon often forms part of them. Ranby found in the sac besides the omentum and 2½ ells of small gut, all the colon except the sigmoid flexure, the commencement of the duodenum, the pylorus and one-third of the stomach.* [5]

Varieties in the Form of the Hernia.—In large herniæ the sac may be irregular in outline and present numerous eminences and depressions. Occasionally the hernia is cleft by a deep vertical sulcus. This appears to be usually due to the omentum adhering to the upper and lower edge of the opening, and forming a longitudinal central band tying down the parts beneath.† [6] Malgaigne described a hernia divided into three parts, "hernie trifoliée." In this the cords of the obliterated arteries and vein appear to be carried forwards by the protrusion, still adherent to the umbilical scar, and cause three grooves on the surface of the rupture.‡

Contents.—The omentum is generally in front of the rest of the contents, as in other herniæ, but the bowel sometimes breaks through and is found anterior to the omentum. In rare cases the intestine is contained in an omental sac, and may be strangulated at the mouth of it.[7] Sir Astley Cooper describes a double umbilical hernia, in which the two sacs were side by side, and came through separate openings in the linea alba.

Mode of Onset.—Like ruptures in other situations, those at the umbilicus arise, for the most part, gradually, and increase by slow degrees, whether they occur in childhood or adult age. There are, however, well-attested instances in which this rupture has appeared quite suddenly during exertion. La Vaugnion relates the case of Antoinette Fautres, in Maine, who, when she was big with child, tried to raise a bushel of corn, whereupon, by the violent straining, "the bowels rushed into the navel," as the translator puts it, "with a noise like the report of a pistol." [8] No further mischief occurred to this woman, but in other

* Dr. Thoman quotes from Ludwig Lautschner (Wien, Med. Blätter, 1881, iv., Jahrg. No. 4, 5) a case of large umbilical hernia in a woman, æt. 70, which contained part of the stomach and was as large as the pregnant uterus. After returning from a walk, she complained of thirst, and drank within two hours eight glasses of water and two cups of tea. A little later she felt sick and began to vomit. During a violent fit of vomiting a loud report, audible to the patient and all bystanders, was heard. She immediately exclaimed, "Now something has burst, now I shall die!" She suffered severe pain from that moment till her death thirteen hours afterwards. Among other viscera part of the stomach was in the hernia, and in the abdominal portion of it a rent was found several centimetres long, through all the layers of the posterior wall, near the entrance to the sac. There was no obvious disease of the tunics of the stomach. (Mediz. Jahrbücher K. K. Gesellschaft d. Ärzte, Wien, 1885, p. 49.)

† The author has met with this condition in cases at the Truss Society two or three times.

‡ This condition was previously described by Scarpa, *op. cit.*, p. 387.

cases the umbilicus actually bursts. Thomas Bartholin treated a boy of six months who suddenly developed an umbilical hernia over which the integument was very thin.[9] On the fifth day the skin broke, and the intestine protruded; soon afterwards the boy died. In another case of the same surgeon, a woman's umbilicus burst during labour, and the bowel escaped.[10]

Symptoms in the Child.—The navel ruptures of childhood differ somewhat from those of adults. In the young they have a cylindrical or conical shape when they project much from the surface of the belly, and are often likened to the finger of a glove. When they are small, the form is rounded or button-shaped. They are covered by thin skin, and the scar of the umbilicus is not very readily discerned upon them.

In Adults, when of moderate dimensions, the hernia forms a larger or smaller segment of a sphere, and is usually contracted somewhat at the base of attachment. In other cases the hernia spreads out around the navel without having any considerable elevation. In large ruptures the protrusion appears as a pendulous mass with an irregular, embossed surface. At some point on the lower half of the swelling the scar of the umbilicus, if present, is to be found. Owing to the direction of the navel ring in stout persons, and to the force of gravity, these herniæ increase, for the most part, downwards, and the edge of the aperture of exit is most easily found near their upper border. They are often covered by extremely thin integument, which is adherent to the layers of the sac wall, so that great caution has to be exercised in opening these herniæ. On the other hand, as they almost always occur in stout persons, they may be overlaid by a thick layer of fat. The ruptures of adults may attain a very great size, exceeding sometimes that of the head. The omentum in the sac no doubt participates in the growth of fat over the body, and hence these vast herniæ are produced.*

The overlying integument is much subject to ulceration, and it is not often that a large irreducible navel hernia is seen over which the skin is not scarred by ulcers.

Reducibility.—The ruptures of childhood and adult age not only differ in form, but also in reducibility. Almost invariably they can be put back in the young, and it is well known that a strangulated umbilical hernia at an early age is of extreme rarity. On the contrary, in adult life these ruptures are very often irreducible, and if they are large, can seldom be returned. This arises, firstly, because adhesions are so frequent between the sac wall and the contents; and secondly, because taxis cannot be used with full effect. The umbilical opening in the midst of yielding tissue cannot be fixed, and part of the force used in reduction is lost in

* O'Leary saw an umbilical hernia so large that it reached the middle of the thigh.[11]

displacing the ring. To obviate this difficulty it has been proposed to grasp the swelling near its base, and to carry it forwards away from the belly whilst pressure is made upon it. Looking to the direction which a large navel rupture generally takes, I venture to think that taxis is best made in a line upwards and backwards, and not directly backwards, as is usually recommended. But the most assiduous attempts at reduction frequently fail, and this operation is attended with great pain.

Special Symptoms.—There is no difference in the symptoms of this rupture and of ruptures in general, unless Sir Astley Cooper is correct in saying that it gives rise to more pain, flatulence, and sickness than other herniæ. In childhood very little uneasiness is caused by it; but in adults the pain is often very distressing. Comparing large umbilical and inguinal herniæ, it is difficult to satisfy oneself that the one is attended with greater inconveniences than the other, but doubtless the umbilical are more tender when handled. If the herniæ are not kept reduced, the patients are subject to attacks of severe cutting pain and vomiting, which may be preceded or accompanied by diarrhœa. Very little difficulty can ever be experienced in the diagnosis of umbilical hernia. A subperitoneal lipoma may simulate it, but the lipomata are more common in the linea alba above than at the umbilicus itself. Denonvilliers met with a subserous lipoma at the navel, which occasioned embarrassment, as symptoms of strangulation were present. The tumour was reduced, but the patient died suffering from general peritonitis.[12]

Prognosis.—The prospect of cure in umbilical ruptures differs in children and in adults. In children, spontaneous cure appears to be the rule, and many surgeons have remarked upon it. In the young of some of the lower animals also the same disposition has been observed. Wollstein noticed the cure of navel ruptures in colts,[13] and in the young of dogs and pigs, in whom these ruptures are very frequent, spontaneous cure generally takes place [14] (Segond). It can be easily deduced from Tables XXVIII. and XXIX., that the herniæ of infancy, with few exceptions, do not endure up to adult life. The presence of an umbilical rupture in a person of either sex at the age of seventeen is so extremely rare that we are justified in promising a cure in all cases.

According to my observations, very little care is needed on the part of the parent to obtain a cure; so little, indeed, that recovery in many cases seems to come about spontaneously. In adults, however, the prognosis is by no means good. Cure, if it takes place in them, is quite exceptional. But umbilical herniæ resemble inguinal in this respect, that if the protrusion is kept reduced the opening closes up in great measure. Leblanc saw an umbilical ring so large that it admitted the ends of four fingers. The hernia was carefully kept in for three months, and at the end of that time the aperture was so contracted that it would scarcely admit

the tip of the little finger.[15] There are, unfortunately, many of these severe ruptures which show no such improvement under treatment.

Treatment.—It is evident that the difficulty of keeping the viscera reduced is much greater in umbilical than in other ruptures, not only on account of the yielding nature of the parts, but because much pressure over the front of the belly is insupportable.

The truss for umbilical hernia, recommended by Anthony Le Quin, had a large and round pad, almost like a shield, greater or less according to the size of the tumour, with a button or boss in the middle.[16] The truss, he says, should be as light as possible, and the steel spring should encompass one half the body, that is, from the pad in front to the spine behind, where it should be a little enlarged.

The propriety of using a large pad or shield is obvious, because a pad adapted to the size of the opening would be liable to constant displacement on the convex surface of the belly. The button or plug in the centre of the pad has been condemned by some surgeons lest it should tend to keep the umbilical ring open, but, though I have not observed that it does so, I never use it because there is no certainty that it will keep its place, and because results at least equally good can be obtained without it. The pad should be slightly convex in correspondence with the curve of the abdomen. The truss is more comfortable and more steady if the spring is carried past the middle line behind to the opposite flank, tapering to its extremity, as I have explained in treating of inguinal trusses. A short strap connects the end of the spring with a stud on the centre of the pad in front.

In applying an umbilical truss to a child it may be placed nearly in the horizontal plane with the hernial aperture behind the central point of the pad.

In adults, however, in whom there is generally some embonpoint, the pad should be placed lower, so as to assist in supporting the belly wall below the navel, and the hernial aperture should be just behind the upper edge of the pad. The spring passes around the trunk about midway between the iliac crest and costal arch. When the belly is pendulous, the truss lies in an oblique plane from behind downwards and forwards.

The umbilical truss of Salmon and Ody has a semicircular spring which is fixed behind by a hinge joint to a small pad placed over the spine, and is fixed in the same manner to a somewhat larger pad in front. For the small and moderate sized navel ruptures of adults this is an excellent truss, and is the best known to me. It is not well adapted for large ruptures in adults or for small ruptures protruding from a "fair round belly."

When the Rupture is irreducible, and does not attain great dimensions, a truss such as I have above described, with a large, round,

slightly concave pad, will suffice. If the protrusion is very considerable, a fenestrated truss must be used which is covered in with chamois leather. The circumference of the truss must completely overlap the tumour, but the pad or plate should not be deeply concave. It is usually necessary to make the plate of an oval figure, on account of the lateral extension of the hernia.

Treatment by Operation.—Little need be said of the treatment by operation of non-strangulated umbilical hernia in children. They are so little troublesome, and, even at their worst, improve so rapidly when protected, and terminate usually so favourably, that it would be idle to discuss the indications for operation.

The adults whose cases most stand in need of help, are not, as a rule, well suited for operation either as regards their age, their state of nutrition, or the size of their herniæ.

The dangers of the operation have been so much lessened since the introduction of the aseptic method, that the operative treatment of these herniæ has come into vogue, but as yet we possess hardly sufficient material from which to deduce the rate of mortality and the duration of the cure.

The old operation of Celsus of passing a ligature around the skin at the base of the sac, or transfixing the sac and tying it in two parts, has given place to more efficacious measures. In the operations now generally used, the sac is opened under aseptic precautions. If any adhesions are present, they are separated, and the protruded omentum is ligatured and cut off. Some surgeons remove all redundant skin and sac wall. Mr. A. F. M'Gill, adopting MacEwen's device for inguinal hernia, makes an internal pad from part of the sac, which he fixes behind the closed edges of the umbilical ring in the subperitoneal space.[17] After the sac has been dealt with, the edges of the opening in the linea alba have to be freshened and united by suture. Lucas Championnière has recommended that the incision of the edges and the arrangement of the sutures be made in such a way that the freshened border of one side shall overlap the freshened border of the other. There is thus not juxtaposition of the edges, but superposition. The skin is then closed in the usual way.

REFERENCES TO CHAPTER XXVIII.

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CHAPTER XXIX.

ON VENTRAL HERNIA.

Sites of the Protrusions.—Those hernia which traverse the abdominal parietes at points other than the groin and navel, are called ventral, and any part of the wall of the abdomen may give them passage.* So vague is the position of these hernia that La Chausse declared in his well-known essay, "No certain locus can be assigned to them." It was held by Platner and by many after him that a hernia may pierce the muscular parts of the abdomen by separating the bundles of muscular fibres.[1] If this actually occurs, it is an event of extreme rarity, and indeed it would be difficult to find a well-attested instance of spontaneous ventral hernia in which the neck of the sac was bounded by muscular tissue. In the few cases where protrusions are found in muscular parts it is probable that the muscles have suffered arrest of development, and at the site of the hernia are represented by membrane.†

Ventral herniæ, with few exceptions, protrude through aponeurotic lines or spaces. They appear in the linea alba, in the lineæ transversæ, and lineæ semilunares, and at certain weak spots between the iliac crest and false ribs.

* Guido de Chauliac appears to have first distinguished ventral from umbilical hernia, with which it had been before confounded. (*Op. cit.*, tract. vi., cap. vi., p. 335.)

† Any part of the abdominal wall that has been divided by a wound or a blow, or that has been converted to fibrous tissue by injury or abscess, may be the seat of a hernial protrusion. Of these traumatic cases it is not my intention to speak.

Ventral Hernia in the Linea Alba.

Distinct from Divarication of Recti.—Of all these the herniæ through the linea alba are the most numerous. In certain persons the linea alba is much widened, and the recti abdominis are far apart (divarication or diastasis of the recti), whence arises a protrusion in the middle line of the belly, of which the description has often been included with that of the true ventral herniæ. But as this dilatation of the linea alba has little in common with the ordinary herniæ in the middle line, it will be described in a separate section.

Structure of the Linea Alba.—In consequence of the oblique direction of the recti muscles, the linea alba is much wider above than below the umbilicus. In the new-born it may measure 2 centimetres across above the navel (Féré), but 1½ centimetres below that point the muscles are almost in contact, and the linea alba is reduced to a mere raphe. At each side of the umbilicus it is common to find one of the fibrous intersections of the rectus (lineæ transversæ) which increase laterally the width of the linea alba. The fibres of which this aponeurosis is composed, cross one another at acute angles and form a close meshwork with the meshes disposed horizontally. When, therefore, the fibres are separated so as to permit a hernia to pass, the opening is oval or lozenge-shaped, with the long diameter, as a rule, transverse.

The subperitoneal fat is occasionally collected in a small mass, enclosing a serous sac, behind the linea alba without passing through it;* but more often the fatty layer sends processes through the meshes of the aponeurosis when from any cause they are widened. These fatty processes, often called fat herniæ, which sometimes include a tube of the parietal peritoneum, are thought to facilitate the protrusion of the viscera.[2]

Nature of the Herniæ in the Linea Alba.—The composition of the herniæ in the linea alba may consist (1) of subperitoneal fat; (2) of subperitoneal fat enclosing a process of peritoneum; (3) of a fat hernia combined with epiplocele or enterocele; (4) of a simple epiplocele; (5) of an enterocele, or entero-epiplocele, &c. Garangeot supposed that the herniæ at the upper part of the linea alba contained a portion of the stomach, hernia ventriculi; and this belief was shared by several surgeons of the last century. It was subsequently shown that in the great majority of cases they consist of fat, or of omentum with or without a fatty envelope. There have, however, been several instances in which a part of the stomach has entered these herniæ,[3] but when they contain some viscus

* Two specimens in the Museum of Guy's Hospital well illustrate this condition. Nos. 2506[32] and 2506[48].

other than the omentum, it is generally the colon. Meckel quotes from Monteggia the case of a woman who had a hernia below the navel 6 inches wide which was a true hernia of the stomach. This was probably a case of divarication of the recti.[4] The fatty herniæ which occur above the umbilicus sometimes contain a part of the round ligament of the liver.[5]

Incidence in the Two Sexes.—It has often been stated that ruptures in the linea alba are more frequent among women than among men, but this has arisen from the custom of including the divarications of the recti with the herniæ properly so called. If the divarications are kept separate, the herniæ of the middle line in men are several times more common than in women. In the thirty-eight cases seen at the Truss Society from 1888 to 1890 the male were nearly four times the number of the female; and the same relation has been found when a larger number of cases from former years has been used.

TABLE XXX.

Cases seen in 1888, 1889, 1890, *at the Truss Society.*

Sex.	Inguinal.	Femoral.	Umbilical.	Ventral in Linea Alba.	Ventral in Linea Alba occurring in the cases of Groin Rupture.
Males .	17,538	461	209	15	15 = 30
Females.	1,803	1,197	566	6	2 = 8

Age of Occurrence.—In both sexes it develops about the middle period of life; in women between forty and fifty, and in men a little earlier, on an average. It is quite rare in the first few years of life, but it then affects both sexes equally.

Position of the Herniæ above the Umbilicus.—It makes its appearance almost always between the umbilicus and the ensiform cartilage. In forty cases, in which the exact position of the aperture of exit was noted, the most common site was at or near the mid point between the navel and the xiphoid cartilage, and next to that in the space just above and within 2 or 3 inches of the umbilicus. Sometimes several herniæ occur in the same patient in or near the middle line. E. Woakes met with a man, æt. 61, who had two herniæ in the linea alba, $1\frac{1}{2}$ inches apart, and 2 inches above the navel.[6] The more nearly the ensiform cartilage is approached, the more rare become the ruptures in the middle line. Among the forty cases above mentioned, only one was near the tip of the cartilage. The herniæ high up in the linea alba and those which protrude at one side of the ensiform cartilage, were thought by

Garangeot, Hoin, and others to contain the stomach, but this error was assailed by Gunz and was not long prevalent.[7]

Some of the older writers speak of the hernia which escapes by the side of the ensiform cartilage as if it were not uncommon, and it is difficult to understand upon what they based their belief, for such herniæ are of extreme rarity. So much so, that it may be safely conjectured that very few of those who alluded to this hernia, had ever seen it. In the preface to his treatise on hernia, Arnaud relates the case of a waiting-woman of the Queen's, who had kept her bed for six months for colic and repeated vomiting. He found a little rupture by the side of the ensiform cartilage, to which he applied a truss, and by which she was relieved. Garangeot also records a case in a woman.

Herniæ below the Umbilicus.—The linea alba does not begin to diminish in breadth at the navel, but at a point 1 or 2 inches lower down, and in this space, immediately below the umbilicus, ventral herniæ are not very uncommon. Over all that part where the linea alba is reduced to a raphe, they are seldom met with. They sometimes follow pelvic cellulitis in women, but the herniæ which are not of traumatic or inflammatory origin are very exceptional. Of such only three have visited the Truss Society in the last twelve years. The sac in the herniæ below the umbilicus generally contains the omentum or gut.

Hitherto the herniæ in the middle line occurring in adult life have been under consideration, whilst those appearing in infancy remain still to be noticed.

The dilatation of the linea alba above the navel in the very young, which will be again referred to, is sometimes accompanied by a defect of tissue which leads to a hernial protrusion. These are usually small, and in the vicinity of the umbilicus; occasionally they are multiple, at all times infrequent.

Mode of Origin.—The difference between the mode of origin of the herniæ of the infant and of the adult seems to be that in the latter the interspaces of the linea alba are widened, either by increase of the abdominal contents, by accumulation of fat in the walls of the belly, or by actual stretching from bending the body backwards, whereas in the former it depends upon an arrest of development (Malgaigne). Many cases are recorded of the sudden origin of herniæ in the middle line during exertion. Oskar Witzel cites some cases of his own as undoubted instances of this mode of formation.[8] The defect in all such histories is that, before the patient noticed the protrusion, the surgeon has had no opportunity of assuring himself that a hernia was not already present. So many of these ruptures are absolutely without subjective symptoms, that it is probable that an effort enlarges and brings to notice a pre-existing hernia.

Symptoms.—The herniæ of the linea alba are generally of small size. When they attain large dimensions, they may form pendulous tumours, if below the umbilicus, but above that point they spread out laterally without having, as a rule, much projection in the centre. It is not possible to distinguish with certainty a fatty hernia from one containing omentum adherent to the sac. Both may be irreducible, but may increase on cough. Either may be accompanied by much pain, and be tender on pressure; and certain dyspeptic symptoms may be present also, such as sickness, colic, and diarrhœa. But in the majority of instances they cause no distress, and many patients can leave them entirely unprotected. A lipoma over the linea alba may be mistaken for ventral hernia. There is nothing distinctive in the shape, size, or consistence of the two swellings. The lipoma may be tender, and the seat of much pain. When the fatty tumour is lifted off the abdominal wall, there is no stalk to be felt connecting its under surface with the linea alba, as is the case with ventral hernia. Sometimes, however, it is not possible to carry out this manœuvre.

Treatment.—Herniæ of the linea alba are best treated with an umbilical truss. Pressure generally completely relieves the pain and disorders of digestion, which sometimes accompany these ruptures. For ordinary cases above the navel, there is no better truss than Salmon and Ody's umbilical. The spring is not strong, which is an advantage in situations where little pressure can be borne. Though usually small, these herniæ sometimes spread so widely as to transgress the outer border of the rectus on each side. In such cases, if the hernia is irreducible, a fenestrated truss must be used, and care must be taken that the edge of the truss slightly overlaps the margin of the hernia. For the ruptures below the navel the large form of umbilical truss is preferable.

Treatment by Operation.—There is a growing disposition among surgeons to recommend an operation for cure in these cases whether reducible or irreducible. The patients unfortunately are not always equally ready to submit to operation. In the majority of cases in which the patient suffers little, if any, inconvenience, it is difficult to persuade him of the expediency of an operation, and with the scanty evidence that exists on the subject we are not able to strengthen our recommendation by pointing to the average frequency of strangulation or to the permanence of the cure. When the protrusion, whether a subperitoneal lipoma or a true hernia, causes much pain, there is less difficulty in overcoming the patient's scruples. The operation consists in exposing the tumour, dividing it carefully to ascertain whether it contains a peritoneal sac, and, if so, dealing with the sac either by excision or by MacEwen's method. M. Terrier advises a vertical incision, and, except

in cases of simple lipoma, the inclusion of all the layers of the abdominal wall in the sutures.[9] Looking to the shape of the opening in the linea alba, which is generally wider from side to side than from above downwards, Oskar Witzel unites the edges in a transverse line.

Divarication of the Recti.

The expansion of the linea alba leading to separation of the recti muscles appears under two different aspects, according as it occurs in infancy or adult age.

In Children.—In young children it is not uncommon to find the linea alba above the umbilicus abnormally wide and thin, so that on the least exertion a semi-cylindrical swelling is seen extending from the navel to the ensiform cartilage.[1] The prominence gradually lessens from the umbilicus upwards. This condition is met with in both sexes equally, and as it does not give rise to uneasiness, no treatment is required. During the growth of the child it completely disappears. The bulging is found, as a rule, above the umbilicus; sometimes it extends below the navel for half-an-inch or a little more in correspondence with the lower limit of the broad part of the linea alba. In a boy, æt. 2, with double inguinal hernia, I have seen it involving the whole length of the belly from the ensiform cartilage to the pubes. This, however, is very rare.

In Adults the separation of the recti is found, for the most part, below the navel, and is an affection almost peculiar to women. It occurs in them about the age of thirty, on an average, and is generally due to repeated pregnancies. It often seems to follow twin pregnancies. Among 3625 female patients who visited the Truss Society from 1888 to 1890, 61 had divarication of the recti. In these persons it generally extended from near the umbilicus downwards towards the pubes. Occasionally it affects an equal extent of the linea alba above and below the navel. In one woman it was between the umbilicus and the ensiform cartilage.

When the stretching of the linea alba is extreme, the intestines fall forwards, and in the erect posture are contained in a thin, pendulous bag. Luschka quotes a case, seen by Bamberger, in which the separation of the muscles was so great, that the interval between them took in almost the whole of the anterior wall of the belly. The recti muscles lay in the flanks as rounded, flattened swellings.[2]

Rossetus also relates the case of Catharina Paulina, the wife of a merchant, whose linea alba had yielded below the navel. The hernia hung down between the thighs, and when pregnant, which she twice was, the fœtus was felt in the tumour.[3] There are many other instances

on record in which the pregnant uterus has fallen forwards, as in Rossetus' patient. In ordinary cases, when the recti are set in action a "demi-ovoid or demi-ellipsoid" tumour projects between them. Separation of the recti in women gives rise to manifold discomforts. The patients often complain of much pain in the abdomen, of great tenderness when the part is handled, and of a sense of extreme weakness.

Treatment.—The protrusions can in the majority of cases be successfully treated with an umbilical truss having a full-sized plate or pad. If the muscles are separated very low down, it usually becomes necessary to apply a nicely-fitting abdominal belt, which is kept from rising up by an understrap on each side. But to obtain complete relief the patient should wear over the belt an umbilical truss.

Hernia in the Lineæ Transversæ.

The fibrous intersections of the recti muscles (lineæ transversæ) vary somewhat in number and in position. One is commonly found opposite the umbilicus, one opposite the ensiform cartilage, and a third intermediate between these. When a fourth is present, it is usually below the umbilicus. Their direction is transverse, though occasionally one is placed obliquely. The fibrous tissue does not, under normal circumstances, extend through the whole depth of the muscle, but only through its anterior portion.

Very little has been said by authors of herniæ appearing through the rectus muscle. Oskar Witzel is almost the only writer among those whom I have consulted, who found herniæ protruding between the muscular fibres of the recti, though he does not seem to have been aware of the extreme rarity of such an occurrence. Those cases which I have met with have been rather local bulgings of the muscle than true herniæ.

Position of the Protrusion.– In the linea alba a hernia emerges occasionally at some distance to one side of the middle line, and at first sight appears to come through the rectus. In these cases, according to my observations, the linea alba has been dilated as well as perforated.

Of the herniæ, which appear to come through the rectus muscle, seven have been seen at the Truss Society in the last sixteen years. Five of these were in the transverse line opposite the umbilicus, and the others were above that spot, one on a level with the mid-point between the ensiform cartilage and the navel, and the other a little lower. Five of the herniæ were on the right side, and all the patients but one were well advanced in life. Only two were females.

The treatment of these ruptures does not differ from that of umbilical hernia, as the same instruments suffice for both.

Hernia in the Linea Semilunaris.

Position of the Hernia.—When hernia occurs in the linea semilunaris, it is usually below the umbilicus; and so constant is this, that Dr. Mollière of Lyons has suggested that the fold of Douglas determines the level of these protrusions.[1] The majority of these herniæ are close to the pubes, where they receive the name of direct herniæ. The following observations relate to those protrusions which appear above the level of the direct herniæ. Of fourteen cases of hernia in the linea semilunaris met with in surgical literature, and nine in the records for the last twenty years of the Truss Society, only four were observed above the level of the navel.[2]

Sœmmering briefly mentions a man, æt. 30, who had a hernia in the right hypochondrium,[3] and a case apparently of this kind was described by Dr. Guy of Thorne.[4] A boy, æt. 8, was given an aperient powder at the suggestion of an itinerant quack. Two hours later the child, whilst straining at stool, felt something crack, and a hernial swelling was found below the right ribs. The two patients seen at the Truss Society were boys aged $1\frac{3}{4}$ and 6 months respectively. In both the protrusion was about the size of a Tangierine orange, was reducible, and situated on the right side. The aperture in the elder boy was just below the costal arch, and as large as a sixpenny piece. In the younger child the opening was more oval and placed lower down.

Frequency, Side Ruptured, &c.—According to the cases referred to in this chapter, it appears that the two sexes are affected nearly equally, and on the left side rather more commonly than on the right; that the malady occurs generally after the middle period of life, and that the size of the protrusion may vary from that of a shaddock to a projection so small that it can hardly be felt.

Hernia partially penetrating Abdominal Wall—"Masked Herniæ."—It is a remarkable circumstance, attending herniæ in the linea semilunaris, that sometimes they penetrate only partially the abdominal wall, and form no manifest swelling. This peculiarity seems to have been known to La Chausse, who terms it "a rare and hidden species of hernia." Cases of this kind have been described by Monro,[5] Teale, Terrier, and Furneaux Jordan, and one related imperfectly by Le Dran[6] probably belongs to this class. M. Terrier appears to have had some suspicion that there was a fulness at the lower part of the left linea semilunaris, but it was so indistinct that he opened the abdomen in the middle line.[7] He then found a loop of intestine partly engaged in a small sac that was buried in the linea semilunaris. The case seems to have been one of "partial enterocele." The patient, a man, æt. 63, had had severe

symptoms of strangulation accompanied by pain and tenderness on pressure at the seat of the rupture, yet no tumour was felt, and the operation was done as for internal strangulation.

Mr. Furneaux Jordan's case was that of a lady in whom signs of obstruction had been present for forty-eight hours. There was a tender spot between the umbilicus and groin, and a "certain fulness, not visible, but clearly different from the corresponding spot on the other side of the middle line." The incision was made over the tender spot, and a very flat sac containing bowel was found, whose orifice passed through the lower part of the right linea semilunaris. The author does not say whether the aponeurosis of the external oblique covered the tumour, as it appears to have done in M. Terrier's case. Teale states expressly that the aponeurosis was tightly stretched over the sac in his case, and that the orifice was at the outer edge of the linea semilunaris.[9]

A woman, æt. 25, under the care of M. Gosselin, suffered a sudden pain whilst coughing, a few days before admission to the hospital, and felt something crack in the wall of the abdomen.[10] The pain was always at the same spot, a little above the level of the anterior superior iliac spine in the left linea semilunaris. When the woman was supine, inspection and palpation revealed nothing: when erect or when kneeling on the bed, an impulse on cough was obtained at the painful spot. At this place it seemed as if the abdominal wall was thinned. There was never any external swelling. This case appears to belong to the category now under consideration. A hernia in the linea semilunaris, dissected and described by Mr. Lockwood, had for its sole contents one of the appendices epiploicæ.[11]

Treatment.—These herniæ can be retained usually by a small umbilical truss, if they are below the level of the navel. For one above that level it is sometimes necessary to use a special truss (Figs. 16 and 17) which is described in the section on lumbar hernia.

On Lumbar Hernia.

Of herniæ in the lumbar region very few are to be found, and only one has been dissected. Many instances occur of hernia appearing in this situation after direct injury or abscess, but to such I do not refer.

Spontaneous and Traumatic.—In the lists of these cases given by Baron Larrey[1] and Professor Braun[2] the traumatic are mingled with spontaneous herniæ. The majority of the Baron's are traumatic, and, though Professor Braun has been at more pains to purge his list, there are still six out of his twenty cases that might well be excluded. Mr. Jonathan Hutchinson, jun., though he takes care to distinguish clearly between the two sets of cases, puts them indiscriminately in his Table

as if all were of equal rank.[3] The common forms of hernia are never associated by authors with protrusions of traumatic or inflammatory origin, and it is needless to depart from the ordinary custom in treating of lumbar hernia.

Cases.—Four cases have been seen at the Truss Society, of which I will give a brief account. The first was under the care of Mr. Kingdon, and the case has been alluded to by Mr. Birkett in Holmes' System of Surgery.[4]

On May 24, 1862, a man, æt. 54, came under observation. He was thin and tall, and had suffered for several years from asthma and cough. Eight days previously, whilst he was trying to lift a fire-engine, which he was cleaning, he thought he felt something give way in his back. At night, when undressed, a swelling was found which grew larger, as he coughed. The hernia, when Mr. Kingdon examined it, was the size of the fist, and was situated between the lower ribs and the iliac crest on the left side. It was reducible, and the opening through which it came was small, and just above the iliac crest about 3 inches from the spine at Petit's triangle. It felt crepitant; gave no gurgle on reduction, and started out again on forcible expiration. Mr. Kingdon told me that he took the man to St. Bartholomew's Hospital, where he was seen by Lawrence and the other surgeons, who recognised the swelling as a hernia through the foramen of Petit.

A man, æt. 54, came to the Truss Society in 1884 with a swelling over the left triangle of Petit about the size of a walnut. It increased somewhat on cough, but was not reducible, and therefore some doubt exists whether it was a hernia or a lipoma.

A man, æt. 30, came in 1889 to the Truss Society, who stated that usually after a hard day's work he had pain on the right side in the position of Petit's triangle. An impulse and a bulging on cough were found there, but no complete protrusion.

In 1891, a gardener, æt. 47, presented himself, who had noticed during three months a swelling on the left side of the belly when he was lifting weights. It formed a swelling the size of a hen's egg, and caused a sickening pain, which quite disabled him from work. The place of exit was just in front of the tip of the left eleventh rib. On cough a slight protrusion was perceived, which gave a sense of crepitation when pressed.

Place of Exit.—Up to the date of Grynfeltt's[5] essay in 1866, the place of exit for lumbar hernia, usually given by authors, was the triangle which bears the name of Petit, situated above the iliac crest, and bounded by the adjacent borders of the external oblique and latissimus dorsi muscles.*[6] Grynfeltt, and Lesshaft[7] after him, mention a space below

* Baron Larrey has traced to Paul Barbette the first notice of this hernia.

the twelfth rib which comes into view when the latissimus dorsi is turned aside. Here the aponeurotic expansion of the transversalis is covered only by the latissimus dorsi muscle. Lesshaft calls this the "trigonum lumbale superius" to distinguish it from Petit's triangle, the "trigonum lumbale inferius," and thinks, with Grynfeltt, that it may very well serve for the exit of a lumbar hernia. Though later writers have questioned whether a hernia ever came through this space, the case of Mr. J. Hutchinson, jun., apparently disposes of the doubt, for this hernia escaped by an aperture 1½ to 2 inches above the iliac crest and near the last rib. He says the protrusion was "through the transversalis aponeurosis and the latissimus dorsi, where the latter arises from the strong fascia covering the erector spinæ," thus leaving it somewhat doubtful whether the latissimus was muscular or tendinous at its line of contact with the neck of the sac. Dr. Hume was unfortunately not permitted to make a post-mortem examination in his case, but from the description it is probable that the hernia came by this route. The latissimus dorsi appears to have covered in part the tumour.

The upper triangle is more constant than Petit's, which is frequently absent, either because the latissimus dorsi overlaps the external oblique, or because the borders of these muscles are contiguous. Lesshaft examined 108 adult and 35 infant corpses, and found the triangle of Petit present in 77 per cent. of the adults, and in 25 per cent. of the children. It is obvious, then, that this triangle oftentimes develops as the growth of the body proceeds, and this in some measure explains why elderly adults and not children are principally affected with lumbar hernia. The floor of this lower triangle is covered by a stout fascia, beneath which are the muscular fibres of the internal oblique, and deeper still the aponeurosis of the transversalis abdominis. In some cases, according to Lesshaft, the internal oblique at this spot is wholly tendinous. It may be, then, that herniæ through this triangle are confined to the cases wherein fibrous and not muscular tissues occlude the opening.

Professor Braun, after making a dissection of a case which followed a spinal abscess, supposed that lumbar hernia may escape by the apertures for the cutaneous nerves, for a branch from the posterior lumbar nerves pierces the abdominal wall close to the triangle of Petit. This is a revival of the suggestion whereby Sir Astley Cooper sought to explain the origin of ventral hernia, but it was long since objected that the vessels and nerves run between the muscles, and do not penetrate the whole thickness of the parietes at one spot.

The cases of lumbar hernia, arising without obvious lesion, presented in the Tables above referred to, with those just related, amount to twenty-six (see Table XXXI.), but many are defective in important

particulars. In eleven the protrusion is stated to have occurred at the triangle of Petit; in two it appears to have come by the upper lumbar triangle; in one, to be presently described, near the tip of the eleventh rib; and in one near the tip of the twelfth rib. In others the position of the opening is not clearly defined. The two cases given by Coze, which are quoted by Professor Braun, offer a number of extraordinary coincidences. Both were artillerymen, and were affected about the same time; in both a muscle hernia appeared at the right triangle of Petit, and after an interval of three months in both an intestinal hernia occurred.

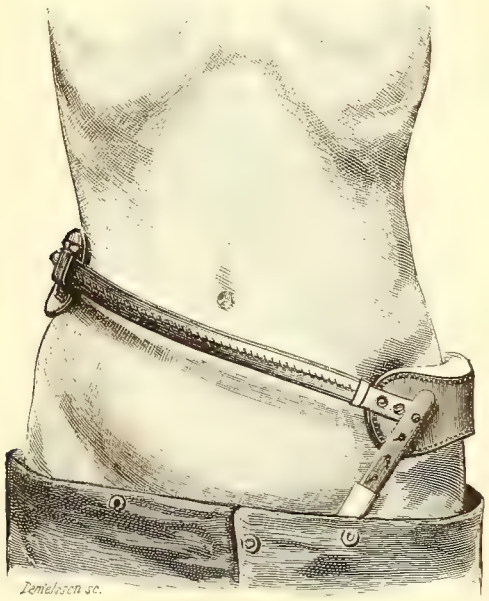

FIG. 16.—Front view of a truss applied to a hernia in the right flank.

Treatment.—Lumbar hernia is placed so far back that it can only be controlled by a special form of instrument.

An effectual truss is not easy to devise, because it is difficult to find a point of counter pressure when pressure has to be made on the loin. This difficulty is overcome by taking the fixed point from the opposite hip, where a curved piece of padded metal rests between the iliac crest and the trochanter (Fig. 16). This plate is prevented from rising by a strap passing under the thigh, attached at the front and back. The spring begins at the fore end of the hip piece, where it is fastened by a ball and socket joint, and, rising upwards across the abdomen,

curves round the flank and ends at the middle line behind on an oval plate, to which it is connected also by a ball and socket joint. The pad of the truss (Fig. 17) is fixed to the spring by a ball and socket joint which allows slight universal movement to the spring, but this is held in check by the leather loops at each end of the pad. The truss here represented was made for a traumatic hernia which followed removal of the right kidney by Mr. Hurry Fenwick. The instrument was invented in 1882 by Mr. Kingdon in conjunction with Messrs. Smith & Brooks

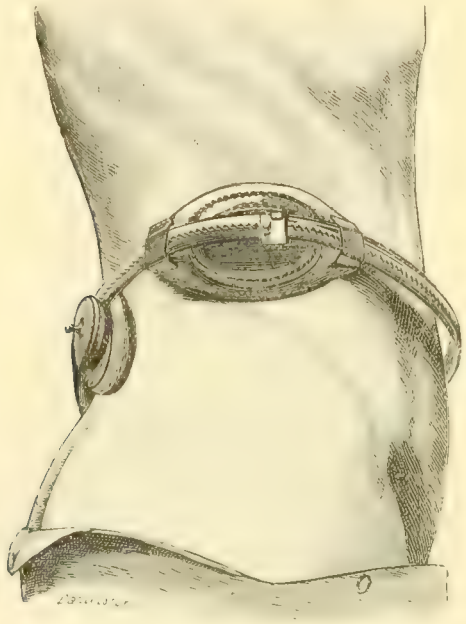

Fig. 17. View of the right flank of the patient shown in Fig. 16, with the pad of the truss in position.

of Hatton Garden. It can be applied to any protrusion in the flank, and, whilst it maintains firm pressure on the opening, permits without displacement all ordinary movements of the body.

Congenital Deficiency of the Abdominal Parietes causing Lumbar Hernia.—Congenital deficiency of the abdominal parietes external to the lineæ semilunares, whilst the recti remain perfect, is an exceedingly rare anomaly. Monro says that his father found the kidneys in two swellings at the back of a child, æt. 6 months, just below the false ribs, and that they escaped by oval openings of considerable size. Not long ago a case was recorded by Dr. Mastin, of a boy, æt. 6, who had had since birth

a lumbar hernia of the left side. It formed a large indolent swelling, 9 inches across, and was apparently due to congenital absence of the muscles between the last rib and the iliac crest.

In 1882, a youth, æt. 16, presented himself at the Truss Society, and has been often seen since then up to the present time. Soon after birth a swelling was observed on the right side, for which a belt was worn during six months. The lump then disappeared, but was again noticed when he began his apprenticeship as a tinplate worker, some

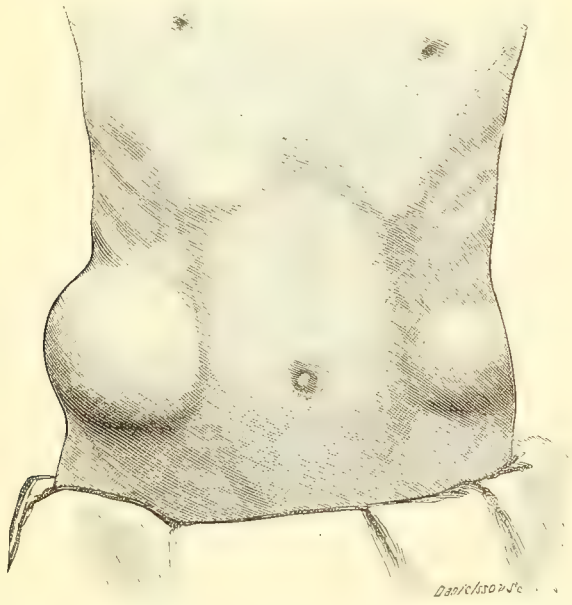

FIG. 18.—View of the abdomen of a male, æt. 18, with congenital deficiency of the abdominal muscles, taken during an expulsive effort.

months before his visit to the Society. He then had a hernia of the size of half a large orange. It was easily reducible, and protruded by an opening immediately below and anterior to the tip of the twelfth rib. The special truss, above described (Fig. 16), was made for him, and in 1884 no hernia was observed. When examined in July 1890, no aperture could be felt, but that part of the external oblique arising from the twelfth rib seemed to be deficient for an inch or an inch and a half at its origin, and presented a remarkable contrast to the corresponding part on the left side.*

* A congenital case of Dr. Q. C. Smith, mentioned in Gross's System of Surgery, vol. ii. p. 562, I have not been able to trace.

Congenital Defect of the Abdominal Wall with Bulging of the Affected Area.—Congenital defect of the abdominal wall may result in a condition short of true hernia, but much resembling it, as was observed in the following case. It was kindly shown to me by Dr. Chaplin at the Hospital for Diseases of the Chest, Victoria Park, and was under the care of Dr. Harrington Sainsbury, who has been so good as to permit me to publish it.

The boy's mother during the fifth month of pregnancy was one day

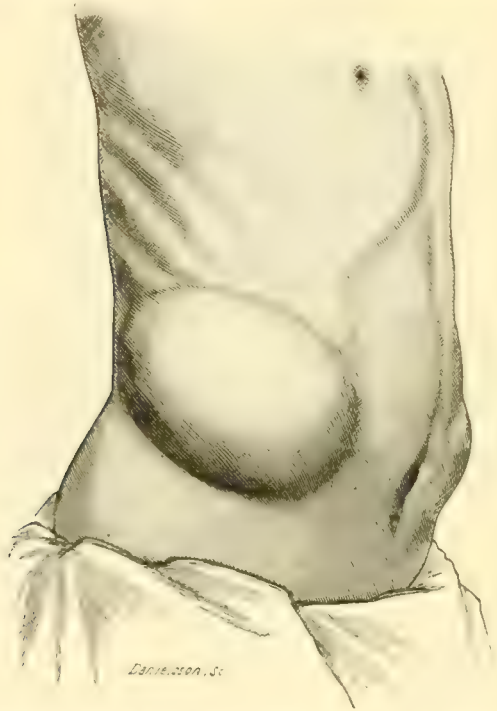

FIG. 19.—View of the same patient as in Fig. 18, showing the whole extent of the projection on the right side during an expulsive effort.

following a tipsy man up a flight of steps, when he reeled and knocked her downstairs. The child was born at term, by a breech presentation. It had a slight anomaly of the heart, with talipes equinus and a defect of the abdominal muscles. At the time of observation he was eighteen, and worked in a printer's office as a "layer on." When the abdomen is at rest, even in the erect posture, nothing unusual is noticed. When he makes an expulsive effort, or any effort, a swelling appears in each flank, as seen in Fig. 18.

The right swelling is the larger, and occupies the space between the costal arch and iliac crest from the edge of the erector spinæ to the linea semilunaris. The swelling is somewhat flattened, and projects an inch and a half to two inches from the abdominal wall. On the left side the outline of the tumour is circular, and on the right almost oval (Fig. 19).

The muscular substance of the abdominal wall at the site of these swellings appears to be wanting, so that when the flank is squeezed between the fingers and thumb, the parietes feel as if composed of membrane. If the abdomen is carefully examined during repose, a curved, sharp, but thin edge, bounding on each side the defective areas, is detected beneath the skin, thus conveying the impression that one or more of the layers of the abdominal wall are absent. The outer segment of this sharp curved edge corresponds to the vertical line drawn through the tip of the tenth rib. This line also marks the outer limit of the protrusion on the left side ; but on the right side the wall of the abdomen, external to the defective space, bulges quite up to the edge of the erector spinæ.

A tumour, like those above described, appearing on cough, was found by Dr. Homer Gage in a girl, æt. 17, on the left side of the chest, and depended upon the absence of five ribs.[8]

Local Bulgings of the Abdominal Wall without Defect of Substance.—Apart from these cases, due to arrest of development, are others, where local bulgings of the abdominal wall occur from no deficiency of the substance of the muscles, but rather from a deficiency in their tone, so that, over a given area, all the layers composing the abdominal wall are distended. These local swellings are occasionally observed in the flanks of young children, and more often in the inguinal regions of adults.[9]

The following Table comprises cases of Lumbar Hernia, not due to injury or abscess, recorded in surgical literature, together with those which have been seen at the Truss Society.

TABLE XXXI.—*Cases of*

No.	Date.	Author.	Sex.	Age.	Side.	Position of Aperture.
1	1731	Garangeot . . .	F.	Adult.	R.	Between the iliac crest and ribs .
2	1738	Ravaton . . .	F.	,,	L.	Lumbar region . .
3	1790	Petit	F.	,,	L.	Petit's triangle . .
4	1802	Monro (congen.) . .	(?)	6 mths.	D.	Lumbar region . .
5	1819	Cloquet . . .	M.	75	R.	Petit's triangle . .
6	1862	Marmisse . . .	F.	62	L.	Lumbar region . .
7	1862	Kingdon . . .	M.	54	L.	Petit's triangle . .
8	1864	Basset (congen.) . .	M.	18	L.	Posterior region of flank . .
9	1869	Marquez . . .	F.	Old.	L.	Petit's triangle . .
10	1869	Levy	F.	,,	(?)	,, . .
11	1869	Triponel . . .	F.	,,	(?)	,, . .
12	1869	Dolbeau . . .	F.	Adult.	(?)	"Lumbar hernia" .
13	1869	Auzias Turenne . .	M.	,,	L.	Left flank . . .
14	1873	J. Apperson . . .	F.	63	R.	(?)
15	1874	Coze, No. 1 . . .	M.	Adult.	R.	Petit's triangle . .
16	1874	Coze, No. 2 . . .	M.	,,	R.	,, . .
17	1879	Broca	M.	70	L.	Between iliac crest and lower ribs.
18	1880	J. W. Currier . .	F.	70	R.	Between iliac crest and false ribs .
19	1881	Gosselin . . .	M.	55	L.	Petit's triangle . .
20	1882	Truss Society (congen.).	M.	16	R.	At tip of twelfth rib .
21	1884	Truss Society . .	M.	54	L.	Petit's triangle . .
22	1889	J. Hutchinson, jun. .	M.	Old.	L.	Trigonum lumbale superius ? .
23	1889	Dr. Hume . . .	M.	53	L.	,,
24	1889	Truss Society . .	M.	30	R.	Petit's triangle . .
25	1890	Mastin (congen.) . .	M.	6	L.	Between iliac crest and last rib .
26	1891	Truss Society . .	M.	47	L.	At tip of eleventh rib.

Spontaneous Lumbar Hernia.

Size of Hernia.	Condition of Hernia.	Result.	References.
Walnut	Strangulated	D.	Traité des Opérations, 1731, p. 369 (Observation 23).
..	Strangulated (operation)	R.	Pratique Moderne de la Chirurgie, 1776, p. 393 (Observation 56).
Child's head	Strangulated (taxis)	R.	Traité des Mal. Chir., 1790, vol. ii. p. 225.
...	Reducible	R.	Essay on Crural Hernia, 1802, p. 8.
	Strangulated (taxis)	R.	Recherches Pathologiques sur les Causes, &c., 1819, p. 4, note 2.
Fœtal head	Reducible	R.	Gazette des Hôpitaux, 1862, No. 43, p. 170.
Fist	,,	R.	...
Apple	,,	R.	Union Médicale, 1864, vol. xxii. p. 578.
Fist	,,	R.	In Braun's Essay, quoted from Gazette Médicale de Strasbourg, 1869, No. 23, p. 274.
...	,,	R.	In Braun's Essay in Arch. f. Klin. Chir., xxiv., 1879.
...	Strangulated (taxis)	R.	Ibid.
..	Incised (fæcal fistula)	R.	Larrey, Recherches et Observations sur la Hernie Lombaire, 1869, p. 24.
Walnut	Reducible	R.	Ibid.
Teacup	,,	R.	Quoted by Mastin in Annals of Surgery, July 1890, xii., Case 26.
Egg	,,	R.	In Braun, loc. cit., p. 212.
6 × 4 centims.	,,	R.	Ibid.
Egg	Irreducible	R.	Catalogue du Musée Dupuytren, 1879, vol. iv., sp. 323.
10 in. across	Reducible	R.	Quoted by Mastin as Case 25.
Tangerine orange	,,	R.	Gazette Médicale de Paris, 1881, p. 123.
Half orange	,,	R.	...
Walnut	Irreducible	R.	...
Fist	Reducible	R.	Brit. Med. Jour., July 13, 1889, and Path. Soc. Trans., 1889.
Child's head	Strangulated (operation)	D.	Brit. Med. Jour., July 13, 1889.
...	Not complete protrusion	R.	...
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CHAPTER XXX.

ON OBTURATOR HERNIA.

Historical Retrospect.—The hernia which escapes from the pelvis through the opening for the passage of the obturator nerve and vessels was first observed by Pierre Arnaud de Ronsil, the father of G. Arnaud, at the beginning of the last century.[1] He presented a memoir on his discovery to the Royal Academy of Sciences, but the fact was not credited, and his paper was rejected. Some years afterwards * Duverney brought to the Academy the pelvis of a woman with double obturator hernia, but his observation, likewise, was not published. According to Hœnel, this hernia was met with by Le Maire of Strasburg, in 1718, and it was demonstrated at Berlin in 1734 by Cassebohm.[2] Garangeot's well-known essay appeared in 1743,[3] and since then cases have been recorded by a great number of surgeons. Objection has been made to the term obturator hernia, because the protrusion does not occupy the whole of the thyroid foramen, but only a small segment at the anterior part.† Hence it was called subpubic hernia (hernie sous pubienne) by Hippolite Cloquet, and this name is still commonly used by French writers.

Direction and Dimensions of the Obturator Canal.—The groove along the under or hinder surface of the horizontal ramus of the pubes, which, together with the obturator membrane and muscles, forms the opening for the vessels and nerve, has a direction downwards, forwards, and inwards. This fact recommends itself to the attention of those who are called upon to use taxis for the reduction of obturator hernia. The bone which partly circumscribes the opening, is so thick that the passage is sometimes called a canal, and Vinson, who measured it carefully, found its length from the inner to the outer orifice to be, on an average, 2 centimetres.[4] The same observer gives the horizontal diameter of the pelvic opening as 14 millimetres, and the vertical as 9 millimetres.

* Circa 1724.

† Garangeot called it "hernie intestinale par le trou ovalaire des os pubis."

Anatomy of Obturator Hernia.—The strong pelvic fascia which covers the upper part of the obturator internus muscle sends a prolongation into the canal, and should form one of the coverings of the sac of obturator hernia. In one case the sac was invested by fascia from that over the obturator externus muscle. The sac is derived from the peritoneum lining the upper part of the pelvis, but in rare instances it has been furnished by the broad ligament. When a viscus descends the canal, it carries before it the peritoneum, subperitoneal fat, and fascia. In its course onwards it may lodge in the canal or insinuate itself between the obturator membrane and obturator externus muscle,* or it may emerge above, or in front of, that muscle, and be covered by the pectineus and adductor brevis. Sometimes a part of the obturator externus is in front of the sac.†

Sac accessible at Inner Side of Thigh.—The tumour in all cases will be most accessible to pressure, when this is made from the inner side of the thigh just behind the adductor longus near the origin of the muscle. It is too deeply buried, as a rule, to be felt from the front or to be affected by pressure over Scarpa's triangle.

The Obturator Nerve, in leaving the pelvis, clings close to the bone, and consequently it should generally be found at the outer side of the sac. Such is its most usual position, and next it is most commonly on the front or front and outer side. It was three times found behind the sac, and only twice to the inner side among twenty-one cases. The nerve seems to take sometimes a curved or somewhat spiral course, so that within the pelvis it is at the upper and outer part of the neck, and externally is found below the sac.

The Artery which accompanies the nerve will be generally at the outer or posterior part of the sac, and as the usual position of the vessel is below or behind the nerve, it will more frequently than the nerve be found behind the sac. In twenty-four cases it was nine times external to and ten times behind the sac; three times to the inner side and twice in front. As it passes the neck of the sac, it occasionally gives off a branch, so that this part is then in relation on three sides with an artery, and sometimes the obturator artery, as it emerges from the pelvis, receives a communicating branch from the internal circumflex which runs behind the sac. The obturator artery generally takes origin from the internal iliac, but, in the cases referred to, it was found twice coming from the epigastric, once from the external iliac, and once from the femoral artery. In the last instance it ascended beneath the external iliac vein to reach the pelvis.

Contents of the Sac.—The sac of an obturator hernia almost always

* Only two instances are recorded among the cases referred to below.

† This was twice noted in the cases referred to below.

contains intestine alone, and is not accompanied by omentum in more than 7.5 per cent. of the cases. The bladder is said to have been found in this hernia by Albinus, and there are well-attested instances in which the uterine appendages have been protruded. In Professor Chiene's case there were three obturator herniæ. On the left side, the sac which was formed from the peritoneum of the broad ligament contained the outer two-thirds of the Fallopian tube and two inches of ileum. The round ligament was in front of the opening, and the ovary immediately behind it. On the right side there were two small obturator herniæ; one of the ordinary kind in front of the round ligament, and one behind it formed by the peritoneum of the broad ligament, and containing the outer half of the Fallopian tube. In Blazina's case, in which also the sac was derived from the broad ligament, not only were the right Fallopian tube and ovary in the sac, but the round ligament entered the hernial orifice and emerged again to reach its usual destination. In Professor Krönlein's case, part of the uterus was in the sac besides its appendages. A very remarkable specimen, prepared by Cloquet, is preserved in the Musée Dupuytren.[5] On the right side an obturator hernia occupies the ordinary position. On the left side the vessels and nerve leave the pelvis at the usual place, but, in the middle of the thyroid space, an orifice is seen of oval form, and 3 centimetres in its greatest diameter. The hernia through this opening in the obturator membrane pushed before it the muscles of that name.

Relation to Sex and Age.—Obturator hernia is so much more common among women that only 4 cases in men were found in a total of 63. It is a malady of advanced life; the average age at the time of observation in 53 persons was 61.3 years. Eschenbach says he met with it in a woman, æt. 24, and in a man, æt. 25, but it is supposed that these were cases of femoral hernia. In 7 persons both the foramina were occupied by a sac,* and among the single herniæ 22 were on the right and 24 on the left side, so that the affection shows no predilection for one side rather than the other.

Premonitory Symptoms.—This hernia is so difficult of detection that its history is that of a hernia left to itself. It has been already noticed that a hernia may exist and give the possessor no uneasiness, or the patient may suffer in various ways without associating his troubles with a rupture. And thus it is, perhaps, that many cases of obturator hernia have apparently no premonitory signs, and the malady first declares itself, when the symptoms of strangulation set in; or, it may be, that the hernia is protruded for the first time and strangulated at the same

* Double obturator hernia was observed by Klinkosch, Camper, Hilton, E. Wagner, Bowlby, Chiene, Richmond.

instant. Possibly the records are defective. Be this as it may, in 30 per cent. there is no previous history.

In the cases in which symptoms have preceded the observation, they are general or local; much more often general, sometimes both combined, in a few cases only local. When a history is obtained, its principal features are the existence of habitual constipation, and from time to time attacks of colic or abdominal cramp which may last a few hours, or more than a day; often nausea, but seldom vomiting. One or other of these symptoms may be absent, and they may attain such a high grade as to constitute strangulation. When these symptoms are present a tumour is looked for, but is often not found.

Local Symptoms.—It is looked for below the inner end of Poupart's ligament, internal to the femoral vessels and below the pubes. A very considerable swelling may exist in the substance of the thigh, and yet produce a scarcely perceptible difference in the outline of Scarpa's triangle. The tumour is more easily felt than seen, and when this can be done, the difficulty is at an end. There is good reason for suspecting that the tumour has been sometimes overlooked, because it has not been sought for in the best way. It is most easily approached from the inner side of the thigh. The thigh must be flexed, rotated outwards, and carried inwards to relax the adductor muscles, and the finger placed against the descending ramus of the pubes behind the adductor longus. Pressure should then be made in the axis of the obturator canal, that is, outwards, backwards, and upwards.

Even so the tumour is not always felt, but there may be undue fulness, or increased resistance, which have been several times noted. Lastly, if external examination fails, there is still one resource which was suggested long ago by Röser. The finger may explore the inner opening of the obturator canal from the vagina or rectum. In a case examined by the author, the finger, when made to sweep round the margin of the obturator foramen, was stopped by a firm cord about the thickness of the thumb, which could be felt to enter the obturator canal. But this manœuvre has not succeeded in every case in revealing the presence of a protrusion.

When strangulation has taken place, the tumour may be tender on pressure, and this fact may be elicited by the proceedings already described, or by making tense the obturator externus muscle, as Mr. Birkett suggested. This can be done by slight abduction of the thigh and strong rotation inwards.

Signs of Pressure on the Obturator Nerve.—The only remaining symptom is the pain and other disorders caused by the pressure of the tumour on the obturator nerve. Attention was first drawn to this symptom in a few brief lines by Howship in 1840,[6] and was brought

into greater prominence in 1845 by Romberg in Dieffenbach's Operative Surgery. It is therefore by some called the Howship-Romberg symptom. This manifests itself in various ways; in a few cases the movements of the limb, both passive and active, are painful. It is not uncommon for the patient to keep the limb in a partly flexed position, and when asked to move it, to raise it with the hands rather than put the muscles in action. Occasionally the patient has complained of numbness, as well as loss of power, which in one case excited suspicion of a partial paralysis. The most usual effect, however, of the pressure is neuralgia in the course of the obturator nerve. Pain at one part or another has been met with in only 42 per cent. of the cases, and even when present, it has not always been rightly interpreted.

It may not be improper to recall here the distribution of the nerve which, though now very generally remembered, has often been forgotten, when attention to its course might have saved the life of the patient. It not only supplies the adductor muscles and the hip and knee joints, but forms a communication at the inner side of the thigh with the internal cutaneous and saphenous nerves. In some instances this communicating branch is continued to the inner side of the knee, and may reach as far down as the middle of the leg.

The pain, as usually described, is of a "cutting," "burning," "tearing" character, and is felt most frequently along the inner side of the thigh extending from the groin to the knee. Occasionally it is severe in the leg, and one old woman is said to have been in the habit of causing her relatives to rub the calf of her leg during the paroxysm. Why it should sometimes extend to the great toe is not very evident, unless some fibres accompany the internal saphenous nerve to the foot. It may be confined to the thigh, and in two instances has chiefly resided in the hip joint. It was thus in one case mistaken for rheumatism with fatal consequences. How difficult it is to read this symptom aright is seen in Mr. Bowlby's case, which was admitted to St. Bartholomew's Hospital under one of the physicians, and not only had the advantage of his sagacity, but was examined in consultation by one of the most subtle surgeons in London, and yet the pain in the hip was wholly misinterpreted.

Diseases Simulating Obturator Hernia.—It may not only be mistaken for rheumatism, but, as Grünberg and Olhausen have pointed out, the pain in parametritis and perimetritis, and in some cases of hysteria, may have the same character as obturator neuralgia. Krönlein, moreover, had a case of suppurative peritonitis in the left iliac fossa, which was accompanied by pain along the inner side of the left thigh, and tenderness on pressure below Poupart's ligament at the inner part. It thus simulated, in a measure, obturator hernia.

Dr. Mason's Case.—Before passing to the treatment of this rupture

in its non-strangulated state, a case may be briefly described which came under the author's notice, and which gives a faithful sketch of the effects of the hernia, and illustrates very well the difficulties of treatment. The case is recorded with all its details by Dr. John Mason, of Windermere, in vol. xxvii. of St. Bartholomew's Hospital Reports, p. 65. The patient was sent by him in 1890 to the Truss Society for the opinion of my colleague, Mr. John Langton, but as he was on leave at the time, the woman came under my care.

She was forty-eight years of age, and had had eight children. At the time of her visit she was lean, but was then recovering from severe illness. Since she was thirty-two years old, she had been subject to attacks of severe pain recurring at intervals varying from one to three months. She was not able to trace their occurrence to the use of extra exertion. The pain usually lasted about five hours, and was relieved by the recumbent position and stupes. It was felt in the right groin, and extended down the inner side of the thigh to the inner surface of the knee joint. Sometimes it seemed to proceed from the groin across the belly to the left hypochondrium. Vomiting always attended the pain.

Whilst engaged in laundry work on Christmas Eve 1889, she was attacked by the pain. Not being able immediately to lie down, she continued at the wringing machine for near an hour, when her suffering was so great that she was compelled to go to bed. The pain extended from her stomach to her knee. She became very ill, and appears to have suffered for thirteen days from strangulation with fæcal vomiting. The bowels at length acted in response to injections, but sickness continued, though not of the same foul character, for eighteen weeks.

During the first thirteen days of her illness a tumour was noticed in the right thigh. The patient herself observed that there was "wind in this swelling," as she heard gurgling. This was disregarded by her medical attendant. At the end of eighteen weeks, Dr. Mason was sent for, and he immediately recognised the tumour as an obturator hernia.

At that time its size was equal to a cricket ball, and by repeated taxis Dr. Mason was at length able to reduce nearly the whole of it. Soon after reduction it would descend again. When the patient attended at the Truss Society, Scarpa's right triangle was observed to be fuller than the left, and the inner boundary of that space had a more rounded outline than on the other side. On palpation a tumour was felt deep in the thigh. At the upper part it could not be defined except so far that the femoral artery lay along the outer margin of its anterior aspect. When the muscles were put in action, the adductor longus and pectineus were felt in front of the swelling. The lower limit of the mass reached the junction of the upper and middle thirds of the thigh, and ended in a rounded but ill-defined extremity. It was somewhat cone-shaped, very

firm and uneven, indolent, and not tender. When the finger explored the margin of the thyroid foramen from the vagina, it was checked by a firm, thick cord entering the site of the obturator canal. There was much pain at that spot during sexual intercourse. Dr. Mason was always able to reduce this tumour, except a very small remnant.

Treatment.—The deep situation of the obturator foramen in the thigh renders it scarcely possible to apply against that aperture effectual pressure by means of a truss. Looking to the great discomfort to which these patients are subject, and to the danger under which they live, which is expressed by the high death-rate (84.4 per cent.) among cases of strangulation, the author can find no alternative but to recommend an operation for the closure of the sac. In the majority of cases, in which the malady only becomes known to the surgeon when the patient is advanced in life, the success of an operation is somewhat problematical; but in a case which is detected early, and in that last narrated the symptoms dated from the age of thirty-two, there could be little objection to performing an operation and approaching the sac from the pelvic side of the opening.

The subject of the strangulation of these herniæ will be found in the Second Part of this work.

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CHAPTER XXXI.

ON ISCHIATIC HERNIA.

In very exceptional cases some of the viscera may leave the pelvis by the great sacro-sciatic notch. But the instances on record are so few, and, for the most part, so imperfectly described, that little is known of this hernia.

Cause.—Monro considered that it was due to a congenital defect of the parts which form the opening,[1] but no important deficiency has been observed in the cases submitted to dissection. In 17 cases, 7 appeared in infancy or at birth. The two sexes seem to be about equally liable, and one side is not more commonly affected than the other.

Contents.—These herniæ may contain the omentum and intestine, or the ovary, or a part of the urinary bladder. Camper discovered the ovary in a left ischiatic hernia in 1759.[2] M. Routier met with one of these organs, enlarged by cystic disease, which he removed through an incision in the buttock with complete success.[3] Haller was aware that the bladder may escape in this situation,[4] and Schreger relates the case of a one year old boy in whom the protrusion of a part of it was mistaken for a cyst, and was removed by operation with fatal consequences.[5] Meinel attended a new-born child in whom he found a hernial sac projecting through the great sacro-sciatic notch into a large serous cyst. The sac wall appears to have been closely adherent to the cyst wall along the line of contact.[6]

Anatomy of Ischiatic Hernia.—The exact position of the opening through which the hernia descends has seldom been defined. Felix Delpech has maintained that the place which would give the easiest exit is at the higher part of the sciatic notch near the upper edge of the pyriformis muscle,[7] and it was here that the hernia protruded in the case of the celebrated Dr. Jones of Barbadoes, which has been related by Sir Astley Cooper.[8] König also states that the protrusion is generally above the pyriformis. Yet in Camper's, in Meinel's, and in Schreger's second case[9] the parts escaped below the pyriformis. Hyrtl thought that a hernia through the lesser sciatic notch had never been observed, but Schillbach appears to have met with one in a woman. Strangulation occurred in this case, and the sac contained one of the ovaries.[10] A portion of the bladder also was protruded apparently through this opening in a case of Allan Burns' communicated to Sir Astley Cooper. In the cases of Dr. Jones and of Meinel the pelvic fascia was observed

to form one of the coverings of the sac. Within the pelvis the hernia is anterior to the pyriformis muscle and sciatic nerve. On entering the thigh the sac crosses over the nerve to its posterior surface, and is covered by the glutæus maximus. As the rupture enlarges, it emerges from beneath the lower border of the glutæus and descends the thigh, or may pass forward above the trochanter towards the groin.[11]

Symptoms.—When the hernia is small and makes no obvious swelling in the buttock, it is found at the spot where the sciatic artery is tied just outside the pelvis. A line is drawn from the posterior superior iliac spine to the trochanter major, rotated inwards, and about half-an-inch below the junction of the upper with the middle third of this line the hernia enters the buttock. Wassilieff found an ischiatic hernia in this way.[12]

When the rupture forms a large tumour, it must be distinguished from lipoma, cyst, hæmatoma, abscess, and, according to Fischer, from aneurism of the glutæal and ischiatic arteries.[13] In infancy it may also be mistaken for spina bifida. Of all these affections a cyst is the most likely to be confounded with ischiatic hernia, on account of the occasional occurrence within the sac of fluid, or of a part of the urinary bladder, or of a cyst in front of the sac, as in Meinel's case. But the diagnosis has not been difficult in regard to the other diseases.

When ischiatic hernia is attended with pain, this may be felt in the buttock, or may extend from the loins to the genitals, or may pass down the thigh.[14] In Dr. Crossle's case the presence of the hernia caused the patient to walk a little lame.[15]

Treatment.—The difficulty of applying a truss to this hernia must arise from the varying size of the buttock in the sitting and in the standing position. The pad would be supported on an arm fixed at the back to the spring which encircles the pelvis.

Strangulation.—There has been some difference of opinion as to the direction of the incision in the stricture, when a hernia of this kind becomes strangulated. Sir Astley Cooper recommended that the stricture should be divided by cutting forwards. Le Dentu advises making several small incisions on account of the proximity of so many vessels to the neck of the sac.[16] It may be questioned whether it would not be more prudent, instead of opening the sac in the buttock, to perform a median laparotomy, and to approach the hernia from the pelvis.

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CHAPTER XXXII.

ON HERNIÆ THROUGH THE OUTLET OF THE PELVIS.

The changes in the level of the pelvic viscera, which manifest themselves as Prolapses and Procidentiæ, do not come within the scope of this work, and will not be more specifically referred to. The present chapter will be restricted to the consideration of the herniæ which descend through the lower outlet of the pelvis.

Boundaries of the Outlet.—The boundaries of this opening consist of the symphysis pubis in front, of the coccyx and great glutæi behind, of the pubic arch from the symphysis to the ischial tuberosities at the sides, and of the great sacro-sciatic ligaments which extend from the last-named processes to the coccyx. Through this outlet pass the rectum and urethra in both sexes, and the vagina also in the female. Between these several tubes and the wall of the pelvis the space is closed by the levator ani and coccygeus muscles. These muscles are lined within by the pelvic fascia, and to some extent by peritoneum.

Infrequency of these Herniæ.—In spite of the comparatively weak and yielding nature of the parts which close the lower opening of the pelvis, herniæ rarely occur through them, and surgeons have often

attempted to explain this apparent paradox. It appeared probable to Sir Astley Cooper and Schreger[1] that the floor of the outlet escapes the direct impact of the viscera by reason of the normal oblique inclination of the pelvis, and Jacobson recorded a case of vagino-perinæal hernia in which he found the pelvis much less inclined than usual.[2] Scarpa, on the contrary, considered the structures closing the pelvis as so elastic and resistant that he expressed surprise that a hernia should ever appear in this situation.[3] I have already called attention to the infrequency of hernia through muscular planes, and the floor of the pelvis forms no exception to this rule.

Classification.—Very little is known, from actual dissection, of the site of these protrusions at their origin within the pelvis, for only a few post-mortem records of such cases are extant. The herniæ are therefore necessarily classified according to their position at the surface.

In man they appear in the perinæum (perinæal hernia) or ischio-rectal space (ischio-rectal hernia, Lacoste). In women, likewise, they may present in the ischio-rectal space, or they may protrude into and from the vagina (vaginal hernia), or occupy the posterior part of the labium majus (posterior labial hernia, Seiler, or pudendal hernia, Astley Cooper). Sometimes the rupture bulges the labium and vagina at the same time (labio-vaginal hernia).

Relations of the Sac and Place of Exit.—In two cases, which have been submitted to dissection, the hernia protruded the recto-vesical pouch, and the sac was found in the middle line between the bladder and rectum, and close to the latter. In Sir Astley Cooper's case the hernia had not reached far enough to form a projection in the perinæum, and probably escaped observation during life.[4] This he took to be the ordinary rule with perinæal hernia in the male, but in Chardenon's case the sac formed a slight prominence in the perinæum.[5] The relation of the sac to the levator ani is unnoticed by both these surgeons, but the transverse perinæal muscles were flattened on the tumour at its anterior part in Chardenon's patient.

It is only in exceptional cases that hernia bulges the central part of the perinæum, for it generally appears to one side of the middle line. Scarpa met an instance in which the orifice of the sac, one inch in diameter, was a little to the right of the mid-line, between the bladder and rectum.[6] Both those organs were pushed somewhat to the left. The gut at first seemed introduced only between the rectum and bladder, but by following its course it was seen that, when it had approached the neck of the bladder, it deviated to the right under the vesiculus seminalis, and entered the ischio-rectal fossa.* When the perinæum was

* Pipelet, le jeune, also described a case of perinæal hernia in the male to the right of the raphe (Mem. de l'Acad. Roy. de Chir., 1768, vol. xi. p. 284).

dissected, the levator ani was discovered with its muscular fibres separated from one another, of which the thinnest crossed the middle of the surface of the sac. Other fibres, in bundles, were distributed partly on the neck, partly on the fundus of the hernia. The sac rested against the lower border of the glutæus maximus, and was bounded in front by the transversus perinæi. Scarpa supposed that in these herniæ the orifice of the sac descends as the protrusion enlarges, and at length reaches the level of the perinæum.

The space between the rectum and vagina is so narrow, and the attachment of those organs to one another is so close, that the possibility of a true perinæal hernia in the female has been generally rejected by surgeons past and present. When the fold of peritoneum at the deepest part of Douglas' pouch is carried down to form the sac of a hernia, the tumour either enters the vagina or deviates to one side to reach the labium or ischio-rectal space. Sandifort examined the corpse of an old woman from whose vagina a large swelling projected, which contained the greater part of the small intestines.[7] The belly was consequently so flattened that the bones of the spine were not only felt but seen through the abdominal wall. The bowel had descended between the rectum and uterus, and entered a foramen in the posterior and inferior wall of the vagina, which formed the mouth of the sac. In other cases observed during life but not dissected, the hernial orifice has been felt in the lateral wall of the vagina, but an instance of a protrusion occurring through an opening in the anterior vaginal wall has been hardly ever met with. A hernia has been found between the rectum and vagina, forming a protrusion into the latter cavity on the right side, which descended through a firm slit-like opening immediately contiguous to the side of the pelvis.[8] In an earlier case, described by Allan Burns, a gap was discovered between the origin of the levator ani and obturator internus muscles, through which a portion of the bladder passed down to the posterior part of the right labium, and a similar defect probably gave passage to the vaginal hernia just previously described. In several other cases, observed by different surgeons, the hernia seems to have made its exit near the side of the pelvis.

Etiology.—Dr. Ludwig Ebner, in his careful study of perinæal hernia, has made some very judicious observations upon the origin of the malady. Like Richter, Scarpa, and some other later writers, he draws attention to the distance which intervenes between the peritoneum in the floor of the pelvis and the levator ani muscle. In man the peritoneum reaches down to the base of the trigonum, and in woman a short distance along the posterior wall of the vagina. If a loop of gut enters the recto-vesical or recto-vaginal pouch and carries before it the peritoneum, its onward progress in the middle line will be arrested by the firm septum between

the rectum and vagina, or the rectum and urethra, and the sac will necessarily deviate to the right or to the left to enter the ischio-rectal space.* The swelling will now rest on the levator ani, and must pass through or carry before it that muscle, and Dr. Ebner has suggested that this may be facilitated by the existence of gaps in the muscle. After making a number of dissections of the perinæum (42 male and 18 female), he finds that the muscle commonly arises in several portions which in many cases can be without difficulty separated from one another, or may even be far apart, so that Henle is justified in describing it as consisting of three portions, the M. levator ani, the M. ischio-coccygeus, and the M. coccygeus. Among the 60 bodies investigated, Dr. Ebner found gaps between the muscles in 25, and the separation between the coccygeus and ischio-coccygeus was much more frequent than that between the latter muscle and the levator ani.

In one male body a protrusion was met with on each side between the coccygeus and ischio-coccygeus, consisting of the pelvic fascia enclosing connective tissue. On the pelvic side of the muscles a lateral dilatation of the rectum corresponded with each of these bulgings, but did not enter the ischio-rectal fossa. Dr. Ebner does not regard the gaps in the muscular floor of the pelvis as the most essential circumstance in the production of these herniæ. It is the arrangement of the peritoneum in Douglas' space which he conceives may descend abnormally low in consequence of a congenital anomaly, and be the chief predisposing cause. It is not possible, unfortunately, to test the correctness of this view by reference to pathological data, for, as I have mentioned above, the exact course of the hernia is as yet known in only a very few cases.†

Among 40 herniæ through the outlet of the pelvis, which I have collected for the purposes of this chapter, 6 were in males and 34 in

* It has been above mentioned that the sac may enter the vagina in the middle line.

† The conclusions of Dr. Ebner may be here appended (*op. cit.*, p. 81).

1. There is a congenital disposition to perinæal hernia.

2. It has not a traumatic origin.

3. The space between the bladder and rectum, or uterus and rectum, is deeper and more distinct in embryos than in later life. If this cavity persists, thence comes the disposition to perinæal hernia.

4. In embryos of the same age the depth of this hollow is not always equal and constant.

5. The descent of the hernial contents occurs in the middle line at first, but at a lower level a deviation of the sac to the right or left takes place.

6. Perinæal herniæ take their course through the determinate gaps between the levator ani and ischio-coccygeus, or between the last muscle and the coccygeus.

7. These gaps can be frequently proved to exist in man.

8. All herniæ which appear at the lower pelvic aperture are only varieties of one kind of rupture.

The remaining conclusions are of less importance.

females. All were adults, and though there are at least two cases, reputed to be herniæ of this kind, recorded as occurring in children,* one appears to have been a spina bifida, and the other, which was discovered during lithotomy, is susceptible of a very different explanation.

Contents of Sac.—The contents of these herniæ are generally said to be small intestine. The bladder sometimes protrudes, as will be more fully described in the Chapter on Vesical Hernia. In Petrunti's case, in which the hernia formed a projection in the rectum and vagina, an incision was made into the vaginal portion on account of strangulation, and a piece of omentum was found in the sac.[9] Gunz records the case of a vaginal rupture which was incised by a rash practitioner, whereupon the cæcum and a large part of the colon escaped. Gangrene occurred, and the patient died.[10] Louis examined the body of a female lunatic who had suffered from a vaginal hernia, and found within it the sigmoid flexure of the colon. Professor Winckel detected the right ovary near the neck of the sac in a vagino-labial hernia.[11]

In the Male the hernia appears in the perinæum or in the ischio-rectal space. It possesses the ordinary characters of a rupture, and presents no difficulties of diagnosis.

In the Female.—Of those occurring in women, the labial appear to be the most frequent. They are more commonly on the right side than on the left. When small, they occupy the posterior part of the labium majus, and by vaginal examination can generally be traced along the vaginal wall ascending to the pelvis. When the swelling is considerable, it not only distends the labium, but encroaches on the vagina, or may pass backwards to the verge of the anus. Professor Winckel gives a good illustration of this hernia in his Atlas, from the case already referred to. The swelling was as large as the fist, and consisted of two parts, an outer part filling the labium majus, and an inner part, covered by mucous membrane, bulging the wall of the vagina at its entry. The hernia reached forwards to the lower end of the right nympha.

It may happen that the hernia first enters the ischio-rectal space and afterwards invades the labium. This occurred in a woman seen by Hager, in whom the two parts of the rupture formed at different dates. The two swellings were separated by a constriction which was supposed by Hager to be caused by the transversus perinæi muscle crossing the hernial sac.[12]

Herniæ in the anterior part of the Labium which leave the pelvis below the pubic arch are extremely rare. In 1891 a woman visited the Truss Society who complained of pain arising from a swelling in the right labium. The protrusion had been reduced, but a weak yielding spot about as large as the tip of the index finger was felt anteriorly,

* Lacoste and Bromfield.

through the skin of the labium, in the triangular ligament, at which point there was an impulse on cough.

The Posterior Labial Herniæ have not often been mistaken for any other affection; but cysts of the labium have occasionally been mistaken for these herniæ. The error is the more remarkable as the only resemblance between the two is in their form and position. But in rare cases when a labial cyst has attained a great size, it may yield an impulse on cough.

The Vaginal Herniæ generally enter the passage at one side, somewhat high up, and not far from the os uteri. They occur as pendulous swellings, invested with mucous membrane, and may dilate or project from the vaginal orifice. Part of a labial or ischio-rectal hernia may, as it enlarges, bulge into the vagina, in which case the vaginal swelling is secondary. Petrunti records a case in which the sac seems to have come down between the bladder and vagina, and to have bulged into both those cavities.*

Vaginal herniæ have been thought to resemble polypi, but are distinguished by their consistence, by the increase on cough, and gurgling on reduction. These symptoms, however, appear to be not always present, or to be not always diligently sought for. A swelling which protruded from the vagina was removed at the Marine Hospital at Kronstadt in mistake for a uterine polypus. The pedunculated mass, before operation, was of a reddish-blue colour, and felt soft here and there. It was bathed in a foul-smelling pus. Its root extended far up the vagina, but the finger does not seem to have reached the os uteri beyond it. A sound was passed with some difficulty. After death, which occurred in the morning after the operation, an opening was found in the vaginal wall, 5 centimetres in diameter, near the os uteri. This aperture had formed the mouth of a sac which had been removed, and had contained 24 centimetres of omentum and 10 centimetres of the middle of the transverse colon.[13]

Vaginal herniæ are not likely to be mistaken for prolapse of the vaginal wall, for this commonly occurs anteriorly, and has no well-defined neck. In no less than two cases a vaginal hernia has been incised in error for an abscess.†

Ischio-Rectal Herniæ.—The herniæ, which come down in the ischio

* In this case the vaginal swelling was incised, and omentum with foul-smelling fluid escaped. The omentum was removed after ligature, and the patient recovered (*loc. cit.*).

† Dr. Peter Young gives the following list of affections which must be distinguished from vaginal hernia: Prolapse of the vagina, cystocele, rectocele, uterine polypus, vaginal cyst, abscess of vagina, abscess of perinæum, inguinal hernia (Trans. Ed. Obst. Soc., 1880–1882, vol. vii. p. 51). This paper contains several references to this disease.

rectal fossa, present themselves as tumours of considerable magnitude between the rectum and the bone. They may push to one side the rectum and vagina as they descend, or may form an offset projecting into the latter cavity. The external and principal portion of the hernia is usually a large pendulous swelling. In a case delineated by Ebner, the sac took an oblique course towards the opposite thigh.[14] The same authority quotes and illustrates another instance, in which the rupture reached nearly to the knee.

Papen's Case.—By far the most remarkable, and probably the earliest recorded hernia of this kind, was that examined by Papen, whose description, delivered in a letter to Haller, has obtained widespread celebrity. It has often been erroneously cited as a case of hernia through the sacro-sciatic foramen. Papen himself called it a stupendous dorsal hernia.[15]

Anna Elizabeth Voss, æt. 50, a robust peasant woman, whilst engaged in reaping under a very hot sun, fell suddenly dead. When Papen next day came to examine the body, he was seized with horror and astonishment on seeing a tumour, as large as a sack, "surpassing all expectation," hanging down from near the anus to the calves of the legs. The surface was stretched and shining, and covered with a tracery of subcutaneous veins. It had the shape of a large flagon. It was an ell in length, and had a circumference at the lower part of an ell and a half. Near the right side of the anus the tumour diminished gradually to the diameter of a span.

The whole abdomen was seen to be eviscerated. The small intestine, with its much lengthened mesentery, the cæcum and vermiform appendix, were in the sac. Moreover, the lower part of the colon, together with a large part of the intestinum rectum, was adherent in the mouth of the sac. The stomach had a vertical position, so that the pylorus with the duodenum was placed in the pelvis in front of the hernial orifice. The uterus was obliquely inclined towards the same opening, and the right ovary, which was cystic, adhered, together with the Fallopian tube, to the mouth of the sac. When the intestines had been removed, an oblong opening could be seen close to the right side of the anus and margin of the coccyx. It extended towards the os sacrum, and was bounded by the sacro-sciatic ligament and the ischial and pubic bones.

Ten years before her death the woman had noticed a small lump at the side of the anus, which gradually increased in size. At stool she was obliged to support the whole sac on her arm, and turn her body towards the left side. When she was at work, she supported the sac with a dorsal sling.

The herniæ through the outlet of the pelvis sometimes cause no pain or discomfort, but more often the patient complains of the symptoms that ordinarily accompany ruptures. Local pain of an aching or burning

character, and a sense of weight in the perinæum, pain also in the hypogastrium and colics, are the most common symptoms. In addition to these, a few patients have complained of numbness in the thigh and leg, or a sense of formication, and in one case there was so much weakness of the limb that the leg dragged in walking. There is not infrequently difficulty of micturition, or even inability to pass water, till the swelling has been reduced. In such cases a part of the bladder probably enters the hernia.

Reduction.—When it is necessary to reduce any of the ruptures above enumerated, it must be remembered that the orifice of the sac may have sunk down to the level of the perinæum, as Scarpa pointed out, in which case pressure on the external swelling will suffice for complete reduction. In the majority of cases, however, the orifice of the sac will be some distance from the surface within the pelvis, and, in order to return the whole of the protrusion, two or more fingers must be introduced into the vagina or rectum, and the sac pressed between the fingers and the lateral wall of the pelvis.

Treatment.—A pessary has generally been successful in keeping up these ruptures. When the instrument is insufficient, or if the patient is a male, a special truss must be made. Pipelet used an ivory plug, springing from an oblong ivory plate which rested on the perinæum. This plate was provided at each angle with a strap which was fastened to an ordinary inguinal truss surrounding the pelvis.

When irreducible, these ruptures have been supported in a suspensory bag. Several cases have been apparently cured by keeping the patient, after reduction, in a recumbent position with the pelvis high. Professor Winckel recommends in all cases a radical operation.[16]

Strangulation. In the few instances in which it has been necessary to operate for strangulation, there has been no difficulty in returning the parts. Stiegele, without opening the sac, succeeded in returning the contents, after boring with his finger in the surrounding tissues of the ischio-rectal space. It is to be observed that great caution must be used in opening the sac in these herniæ, as they sometimes contain a portion of the bladder, not covered by peritoneum.

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CHAPTER XXXIII.

ON HERNIA OF THE BLADDER.

Cystocele.—It is not uncommon for the anterior wall of the vagina, together with the posterior wall of the bladder, to prolapse and project into the vagina. The swelling, thus constituted, is termed cystocele, but this is not what is meant by hernia of the bladder.

Hernia of the Bladder.—A part of the bladder may leave the abdomen by one of the openings traversed by ruptures, and the organ then becomes divided into two parts connected by an isthmus which occupies the hernial aperture.

Historical Note.—Felix Platerus first discovered this hernia in the person of a fisherman of Bâle who had long had a swelling of the scrotum.[1] Suddenly he was attacked with retention of urine. Neither the catheter nor other means gave him relief. His abdomen began to

swell, and to be very painful. In spite of all endeavours he could not satisfy his urgent desire to pass water, and he was in great jeopardy. Platerus conjectured that the scrotal swelling was the cause of the retention, and made an incision into it. The urine flowed out abundantly, the symptoms were relieved, and the patient recovered with a fistula from which his water flowed for twenty years. An entero-epiplocele was in front of the hernia of the bladder.*

Etiology.—Platerus, like so many surgeons after him, was puzzled to understand how the bladder, which is so firmly fixed in the pelvis, could reach such a distant situation, and even at the present day, though so many cases have been recorded and dissected, the etiology is by no means established. Mery, who described three cases at the beginning of the last century, attributed the hernia to a defect of development.[2] To this it has often been objected that the protrusion occurs almost exclusively in adults, and for the most part in those so well advanced in years that a congenital defect can be of little significance. Moreover, there is no defect of the bladder yet known which would favour the production of this hernia. On the other hand, a protrusion of the bladder, though very rare, is not unknown in early life. Pott operated upon a boy, thirteen years old, whose hernia, consisting of part of the bladder not invested by peritoneum, had been noticed at the age of six in the right groin.[3] Schreger relates the case of a one year old infant whose hernia was congenital. Part of the bladder had passed through the left great sacro-sciatic notch between the pyriformis and gemellus superior, and formed a swelling, resembling a cyst, in the glutæal region.[4] The external portion of the viscus was a part of the fundus which to some extent was covered by peritoneum.

There is nothing in the history of development which affords a satisfactory explanation of such cases. Even if the apertures by which the hernia passed were wide in consequence of defect of development, the entrance into them of a part of the bladder before it has been subject to unnatural distension is hardly intelligible. No doubt the bladder in the infant takes up a relatively larger amount of the space within the pelvis and lower abdomen than in older persons, and under normal circumstances comes more readily into contact with the openings in the abdominal and pelvic parietes. Yet, even so, the frequency of a widely patent

* Verdier (Sur la H. de la Vessie, Mem. de l'Acad. Roy. de Chir., 1753, vol. iv. p. 171), quoting from Gunz (de Her.) says that herma of the bladder, according to Thomas Bartholin, was discovered by Giovanni Domenico Sala. Platerus, however, was born in 1536, and died in 1614, when the first edition of his Observations was published. Sala was born in 1579. Bartholin was born in 1616, and speaks of Sala as his old master and friend who was living in 1620 (not in 1520, as Verdier has it) when he observed the case of hernia of the bladder. Gunz is, therefore, probably in error when he says that the honour of the discovery should be accorded to Sala.

inguinal canal and the extreme rarity of a vesical hernia in infancy, suggests the introduction of some other unknown condition for the production of hernia of the bladder in early life.

In a large majority of cases this hernia is found in the scrotum of elderly males, and though they may have suffered for years and even since childhood from inguinal hernia, the symptoms which indicate the presence of the bladder, come on only late in life. After dissection, when the intra and extra pelvic portions of the bladder are together, the viscus is usually larger than normal. Perhaps for this reason Verdier supposed that the bladder is dilated by frequent retention till it comes within the range of the inguinal or femoral rings, through which it is pushed, like any other viscus, when it is partially empty and lax. In view of the necessity for the bladder to come into contact with one of the hernial openings, Garangeot remarked that the viscus in those women who have borne many children is extended laterally so as to resemble a little cask placed transversely. But so far as the increased capacity of the organ acts as a cause, it must be remembered that the number of cases of dilated bladder is infinite, and of hernia of the bladder extremely few ; and if one may judge from the slow and gradual alteration in the size of the swelling, the enlargement of the organ takes place to a great extent after the formation of the hernia.

It is evident that if a considerable portion of the bladder is drawn through the inguinal canal, the part of it covered by peritoneum will be involved in the protrusion. Thus in front of the herniated bladder a serous cavity will be placed which may contain bowel, &c. There will be two herniæ, as Garangeot observed, one of the intestine in front and one of the bladder behind. This combination of herniæ has been noticed in a large proportion of these ruptures, so that it has been supposed that an inguinal (or femoral) hernia may drag the peritoneum between the mouth of the sac and the bladder till that organ is sufficiently displaced to enter the aperture in the groin. According to Despres, an ordinary hernial sac may be reduced into the abdomen after its contents, may there become adherent to the bladder, and be again protruded carrying the bladder with it.[5] But that protrusions of the bladder are not commonly brought about in these ways is probable, not only because the bladder is so seldom found even in the largest ruptures, but also because a fair number of vesical herniæ have no peritoneal investment. Verdier was of opinion that the bladder usually came out first, and that the intestinal hernia was secondary.

It may be conjectured that there are at least three conditions which must concur to produce a vesical hernia, viz., a sufficient opening in the abdominal parietes ; a bladder so much distended or displaced that a part of its wall comes in contact with the opening ; and a bladder whose

wall is so distensible that it yields readily either to the intra-abdominal pressure or to the hydrostatic pressure within itself.

Morbid Anatomy of Vesical Hernia.—When the bladder escapes by the inguinal canal, it necessarily becomes bent, so that its anterior surface is posterior, and rests against the back of the scrotum. The peritoneum may invest the whole of the scrotal portion as in Krönlein's case,[6] so that the bladder can be easily reduced into the abdomen; or it may cover all but a little space at the posterior part near the mouth of the sac;* or it may be found only in front whilst the bladder is adherent to the back of the scrotum by connective tissue. Lastly, the extra abdominal part may be wholly divested of peritoneum.

That portion of the viscus in the mouth of the sac, which connects the intra and extra pelvic portions, is generally reduced to a narrow tube. Pott found it "about the breadth of the largest wheat straw." It may be one inch in diameter, or even larger.

The whole bladder in some cases is outside the abdomen, so that the urethra, both in the prostatic and membranous portions, is greatly elongated. The lateral ligaments and urachus are also loosened and much lengthened. More commonly a part of the viscus remains in the pelvis, and in rare instances only a diverticulum of the organ leaves the abdomen.

The scrotal portion has several times been found to contain one or more calculi. The formation of stone is probably due to the inability of this part of the bladder to empty itself completely, which arises, not only from the thinness and weakness of the vesical wall, but because the intra-abdominal pressure, so far from aiding the expulsion of urine, tends to drive the stream into the scrotal sac. In cases where an enterocele has been in front of the bladder, strangulation has occasionally happened, necessitating herniotomy. Maurin found the gut gangrenous under these circumstances.[7]

Occurrence in the Two Sexes, &c.—Hernia of the bladder is usually met with in elderly males, and is very rare in women in every situation.

Among 36 vesical hernia
26 were scrotal.
4 ,, labial.
2 ,, femoral.
1 was vaginal.
1 ,, perinæal.
1 ,, ischiatic.
1 ,, ventral.

Symptoms.—Some patients have not suffered any inconvenience or trouble in micturition at any time; some have had this difficulty shortly

* See a specimen of Sir Astley Cooper's, Guy's Museum, No. 2487.

before death. But, as a rule, there is a difficulty in passing water, not from any obstruction of the urethra, for in none of the recorded cases was a stricture present, but from inability to drive the urine from the outer to the inner bladder.

The patient seems to have an instinctive perception of the mode of emptying the bladder. Mery was sent for to a monastery, where he found the general of the order, a man over eighty years of age, complaining of difficulty in passing water. A considerable tumour occupied the right side of the scrotum, in which Mery at once detected fluctuation. The scrotal coverings were thin, but the swelling was not translucent. Mery was disposed to think it a hydrocele, when the "holy religious," seizing the scrotum with his hands, compressed it. Urine flowed from the penis, and the swelling entirely subsided. Mery then informed his patient that he had a hernia of the bladder, and this diagnosis was verified soon afterwards post-mortem.

As in Mery's case, the patient is often not able to micturate till he makes pressure on the swelling. When he passes water, the tumour subsides, and as his urine re-collects, it gradually fills out again. If water is thrown into the bladder through a catheter, the scrotal part can be filled at will and again emptied by pressure.

The extra pelvic portion, which is often irreducible, remains in the scrotum as a loose, soft mass, like a thickened hernial sac, till it fills, and then gives a sense of fluctuation on palpation. It is not in every case, however, that the scrotal portion can be completely emptied, for it sometimes is only diminished in size by pressure. The hernia is not likely to be mistaken for a hydrocele of the tunica vaginalis, because it is not translucent, and the testis can be felt below it. But in one case the testis was flattened and at the back of the scrotum, and was not perceptible till it was discovered on dissection.[8]

When the extra pelvic portion of the bladder is compressed, the patient has a desire to make water, and, if the pressure is continued, drops of urine escape from the penis involuntarily. This rule seems to be liable to some exception, for Pelletan, when about to operate upon a strangulated scrotal hernia, observed that if the swelling was seized for taxis, one or sometimes two jets of urine passed. He therefore thought the case was one of hernia of the bladder, but after death that organ was found unmoved in its usual situation.[9] The patient with vesical rupture also suffers from frequent micturition, which may endure for many years, and he has pain in the region of the bladder and hypogastrium.

In Labial Hernia containing a part of the bladder, the symptoms, except for the difference of situation, are not essentially different from those above given for inguinal vesical hernia.

The extraordinary case of vesical hernia dissected by Allan Burns has already been referred to, in which a part of the bladder entered the right labium, and a part on the left side passed between the levator ani and obturator internus to enter apparently the lesser sciatic notch.[10] It is not uncommon to meet with cases described as vaginal hernia of the bladder, which are evidently cystoceles, but Mundé has recorded one in which, after reduction of the bladder, he detected a fissure in the anterior vaginal wall, formed by a longitudinal separation of the muscular fibres of that canal.[11] Levret met with a femoral and vaginal hernia of the bladder occurring together in the same person.[12]

Perinæal Vesical Hernia.—Pipelet described a vesical hernia in the perinæum of a male who suffered from a dull pain and a sense of weight in the part, and could only pass small quantities of water at a time.[13] He was obliged to press on the perinæum to micturate and to stoop forwards. The swelling was about the size of an egg, and entered the pelvis by an opening on the right side of the raphe. Pipelet invented a special truss for it which has already been described (p. 294).

Ventral Vesical Hernia. Reboul described a hernia of the bladder whose anterior and upper part had passed through an orifice in the abdominal wall above the symphysis pubis and between the recti muscles.[14] The protrusion was about the size of a hen's egg, and descended in front of the pubes to the root of the penis. It was reducible, but was not invested by peritoneum. There was considerable hypertrophy of the muscular fibres of the herniated portion, and it was noted that the man, who was eighty-five years of age, had not had trouble with his water.

Treatment.—If a vesical hernia, whether single or in company with enterocele, is reducible, there need be no hesitation in applying a truss. But if one or both are irreducible, the question of treatment may present some difficulty. Mery directed his patient not to wear a truss under these circumstances. Some have feared to attempt reduction of the bladder lest the part should be incapable of contraction when it is again within the abdomen. This danger seems imaginary rather than real. In a case of scrotal hernia I would advise the use of the hinged cup truss (p. 219), in order to keep up gentle and steady pressure on the swelling, whereby its gradual reduction will be accomplished. Some would prefer to perform a radical operation, but these patients, on account of their age, are not very favourable subjects for surgical interference. If the hernia is in some part other than the scrotum, and is irreducible, mechanical pressure, steadily maintained, will in all likelihood secure reduction.

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PART II.—ON RUPTURES WHEN THE FUNCTION OF THE BOWEL IS INTERRUPTED.

CHAPTER XXXIV.

ON THE DOCTRINE OF STRANGULATION.

The Strangulation of Hernia. A rupture, so long as it keeps its ordinary state, is a serious, sometimes a grievous inconvenience, but is not immediately dangerous to life. Yet, at any moment, a sudden increase of the contents of the sac may bring the patient into the utmost peril. He begins at once to suffer pain in the rupture, which spreads to the belly, and he finds that he can no longer return the parts protruded. Vomiting comes on, and, if it continues, becomes stercoraceous, whilst the stools are suppressed. The hernia is said to have suffered strangulation.* Unless the bowel can be reduced, the symptoms continue till death relieves the patient. So sudden a transition from health and activity to a mortal illness, attended with extreme wretchedness, suggested to the ancient surgeons the expressive name, which they have given to this condition, of "miserere mei." †

Earliest Record of Strangulation.—If a passage in Cœlius Aurelianus can be trusted, the strangulation of hernia was known four centuries before Christ, and taxis was practised for its relief by Praxagoras of Cos.[1] In the same quotation from Praxagoras, Professor Albert finds the earliest record of the ancient conception of the cause of strangulation, the "oldest enunciation of the theory of strangulation."

Ancient Theory of Strangulation.—According to this theory, the obstruction was produced by an accumulation of hardened fæces in the protruded bowel. The same explanation was given by Celsus,[2] and was used by all the surgeons after him, with few exceptions, up to the dawn of the last century. The old remedies for strangulation were designed to soften or to dislodge the "hardened fæces;" the warm bath, which is mentioned by Avicenna,[3] the poultices to the part, the clysters, and

* This word, according to Gosselin, was first used by Riolanus, 1648.

† The condition produced by strangulation was also called ileus.

taxis. Even after the invention of the operation for the reduction of strangulated hernia in the middle of the sixteenth century,* the ancient doctrine continued in full authority.

Lavater's Doctrines.— But towards the close of the seventeenth century other causes were suggested. In Lavater's essay on entero-peristole in 1672 the subject is ably discussed.[4] By entero-peristole he understood compression of the intestine, "whence I call that compression of the intestine variously, constriction, strangulation, and incarceration."

According to Lavater, the compression of the intestine was due to the neck of the sac.† Among the antecedent causes "which first make and foment the disease" he gave the principal place to an accumulation of fæces or of flatus in the protruded gut in conformity with the ancient belief, but he introduced as another cause inflammation of the intestine.

Strangulation caused by Inflammation.—The notion that inflammation first attacked the bowel, which was thus swollen till it became too large for the neck of the sac, was favourably entertained by many surgeons in the last century, and has been from time to time revived without meeting with general acceptance. The inflammation is now generally regarded as a consequence and not as a cause of the strangulation.

Spasmodic Strangulation.—Mauchart, in 1722, in addition to the old theory, mentioned, as causes of strangulation, first, a disproportion between the parts protruded and the ring; secondly, a spasmodic contraction of the ring.[5] It was thought that the neck of the sac might be constricted by a local and long enduring spasm of the oblique muscles. This idea is to be found in the treatise of Dionis (1702),[6] and Mauchart probably obtained it from the surgeons of La Charité and the Hôtel Dieu when he was working at those hospitals in Paris. A number of eminent practitioners, among whom were Richter, Sir Astley Cooper, and Guthrie, believed in the reality of the so-called "spasmodic stricture," but it has been rejected by Scarpa, Travers, and Lawrence, and has been almost universally condemned by later writers. The borders of the openings through which herniæ come are now thought to take only a passive part in producing strangulation.

Refutation of the Ancient Doctrine.—The ancient doctrine which attributed strangulation to an accumulation of hardened fæces in the protruded gut was overthrown by Sharp, who remarked that it is the small intestine which forms the majority of herniæ, and that the contents of the small intestine are fluid. Many years later Malgaigne again demonstrated that strangulation in this sense hardly ever occurs.[7]

* Invented by Pierre Franco in 1546–1549.

† In inguinal hernia it was the neck of the sac aided by the aponeurosis of the oblique muscles.

True or "Elastic" Strangulation.—When a loop of bowel is forced through a narrow hernial aperture, or when more bowel is driven down into a hernia already protruding, there is a disproportion, as Mauchart observed, between the protruded parts and the ring. The opening during the passage of the gut, is dilated to its utmost.* It then recoils and compresses the intestine. Thus is produced a strangulation, *i.e.*, a compression of the intestine and closure of its lumen, which has been variously termed "true," "acute," "inflammatory,"† and, by the Germans, "elastic." It is evident that in this manner any organ or part of an organ that is within the range of the hernial openings, may become strangulated, whether it be intestine, omentum, a testis, or an ovary. By the protrusion of a greater length of a single fold of intestine it might be thought that there would be no increase of compression at the ring, but, as Sir Astley Cooper observes, a proportionally larger quantity of mesentery descends along with the bowel, and thus increases the pressure made by the stricture on the hernial contents.[9] It is reasonable to suppose that the degree of compression to which the intestine is subject, in some measure is proportionate to the size of the opening through which it comes, as well as to the energy of the expelling force. Be this as it may, a difference in the severity of the symptoms has been long since noticed among cases of strangulated hernia, and the attempt to explain these differences has given birth to various theories of strangulation.

Strangulation by Obstruction.—It was supposed by Goursaud that the intestine in a hernial sac may be filled up with alimentary matters till it becomes too large for the neck of the sac or the hernial aperture, and to this condition he gave the name of "Étranglement par engouement des matieres."‡ Travers termed this, secondary strangulation, "in which the gut is confined by distension of its tube."[10] A strangulation produced in this way would give rise to symptoms less severe and less speedy, it was thought, than those of elastic strangulation. In support of his contention Goursaud cited a series of cases which have the following characteristics. A large and old rupture which may have been reducible or has been long irreducible, begins to swell until it becomes tense and hard. At the same time the stools are suppressed, and the belly is slowly distended. When vomiting occurs, it comes late, and is not usually severe. At length the hernia becomes painful, and if not reduced, or if it is not emptied, the operation may be called for. Cases

* This was pointed out by Wilmer (Pract. Obs. on Her., 1788, p. 25).

† Goursaud, whose essay on the different causes of strangulation has been so often quoted by authors, uses the term "Étranglement par inflammation," but explains that the strangulation produces the inflammation.[8]

‡ The word "engouement" was used by Covillard in his Obs. Iatro-chirurg., 1639, Lyon, p. 114, and this is the first mention of it according to Gosselin in surgery.

of this class are very rare, but are clinically distinct, and differ from other strangulated herniæ in the mild and slow progress of the symptoms, as well as in the fact that for a brief period they admit of an expectant treatment.

The Modern Theories.—All the subsequent theories of strangulation which have been put forward to supplement or to supplant that of elastic strangulation, have chiefly an academical interest, and affect in no way the rules of treatment. Most of them rest on the assumption that the pressure within the bowel above the sac, or in the sac, may be suddenly raised by a downrush of intestinal contents, and that this rise of pressure in one way or another, causes obstruction. A strangulation arising in this way has been called *fæcal occlusion*, "*Kotheinklemmung*" by the Germans, to indicate either that the stoppage is produced by the entry of intestinal contents into the loop (Lossen), or that the strangulated loop includes intestinal contents (Kocher).

Theory of Fæcal Occlusion—Röser's Experiment.—Numerous attempts have been made by experiments on the dead body, on elastic tubes, and living animals to explain the mechanism of fæcal occlusion. One of the earliest investigators in this field was Professor Röser, who instituted the following experiment.[11] A loop of bowel, whose mesenteric arteries had been previously injected with water, to imitate the turgid state of the living intestine, was drawn through a ring, having the diameter of a finger. The loop was then partly filled with air or water, or with both. If now the point of the loop was squeezed with a view to reducing its contents, nothing passed into the intestine above the ring. "And yet one can easily push through by the side of the bowel a body of the size of a catheter, and if the bowel is held somewhat to one side, one can look through a free space between the bowel and the ring." The intestine is thrown into folds in the ring, and Röser supposed that these folds act as a valve, which he likened to the aortic valve, and prevent the escape of the contents of the loop. Afterwards it was pointed out that the folds of the gut are longitudinal, and that no valve in the ordinary acceptation of the term is present.

In referring to experiments in which a loop of bowel is drawn through a ring, it will be convenient to name that part of the intestine above the ring, which is entering the loop, as the "importing end," and the part, which has emerged from the ring, as the "exporting end." Röser's experiment, though it does not explain the mechanism of strangulation, as Busch pointed out, yet as it concerns the irreducibility of a protruded loop, is of much importance in this inquiry.

Lossen's Development of Röser's Experiment.—Lossen, by repeating Röser's experiment, found that when the loop was compressed between the fingers, it was quickly emptied in many cases. In others the loop

became tensely stretched before the ring, and its contents were irreducible. During the pressure and consequent distension of the loop more bowel was drawn out through the ring, and this movement only ceased when the closure was complete. Lossen supposed that the mesentery, which was drawn out with the additional bowel, served to close the lumen of the latter, acting as a sort of plug in the ring.

This explanation must be insufficient, if Busch is correct, when he says that he performed the experiment with elastic tubes successfully, but not so often as when bowel was used. On the other hand, Lossen separated the mesentery from the gut, and then the experiment failed; as it did likewise, when he prevented the entry of fresh gut into the ring.

Bidder's Experiment.—Bidder drew a loop of gut through a ring 1 centimetre wide. In doing this the contents were pressed back into the importing and exporting ends on account of the narrowness of the orifice. The empty loop could be again reduced either by pressing upon it or by a pull from the abdominal side. But when the loop was filled by means of a Pravaz syringe with air or water, it was no longer reducible. Bidder observes that a condition similar to this may occur in the human subject, if a loop is protruded, which at first may be empty and reducible, but which becomes irreducible by exudation of fluid into the interior. The loop in Bidder's experiment can be reduced if it is emptied with the aspirator, or if the ring is enlarged. In Roser's experiment, when the apex of the loop is squeezed, the contents distend the ends of the bowel in front of the ring, whereby more bowel is drawn out from the lower (exporting) end and is added to the loop. The mesentery, which accompanies this bowel, diminishes the lumen of the ring, as Lossen pointed out, sufficiently to close the intestine towards the abdomen. Reichel thought that the occlusion was aided by an invagination or tendency to invagination of the mucous membrane on the abdominal side of the ring into the stricture.[12]

The Injection Experiment.—If a loop of intestine is drawn through a ring, and water or air is injected into the upper (importing) end, the results differ according to the size of the ring.* If a wide ring is used, that is, a ring wider than the filled, but not distended, importing end of the loop, together with the collapsed exporting end, the fluid injected into the bowel above the ring will flow through the loop without hindrance. Reichel points out that in this case the fluid which traverses the loop, reaches the exporting end and escapes, before the importing end has become distended, so as to compress the former.[14] If a small ring is used, 1 centimetre in diameter, and the injection is repeated, the upper (importing) end of the intestine becomes distended up to the ring; no fluid enters the ring, but the loop is drawn out of it into the belly.[15]

* The first experiment of this kind was made by Dr. James O'Beirne in 1839.[13]

The occasional occurrence of spontaneous reduction of a strangulated loop has been explained in this way. Sharp (1750) thought it probable that small doses of purgatives might so augment the peristalsis of the intestines that the bowel above the ring would draw the loop out of the sac.[16] If in the experiment the loop contains any fluid, the bowel is drawn out of the ring until the loop is tense, and then moves no further. A different result, again, is obtained by using a ring intermediate in size between the two former. When the experiment is now repeated with a ring 2 centimetres in diameter, the fluid is no longer arrested above the orifice, but enters and fills the loop. Yet the fluid does not pass beyond it; not a drop repasses the ring, but the loop is distended, and, as a consequence, more bowel is drawn in from the lower (exporting) end.

Busch's "Abknickung Theory."—Busch supposed that the pressure within the loop, caused by the injection, was greater on the convex than on the concave side of the bowel, and that therefore the loop had a tendency to straighten itself. He thought that this would have an effect equivalent to drawing the (exporting) end of the loop against the edge of the ring, and would produce closure of the bowel at this part. He termed this "Abknickung."* Busch believed, moreover, that if the injection was continued, the same thing would happen at the place of entry of the bowel, and that thus both ends of the loop would be closed to the abdomen.[17]

Lossen's Theory.—Lossen showed that the upper (importing) end of the loop is not closed, but remains in communication, though it may be but by a narrow passage, with the bowel above. He observed, that the terminal (exporting) part of the loop was closed, not by "Abknickung," which he regarded as the effect and not the cause of strangulation, but by the pressure of the distended upper (importing) end against it.[18] These two theories, which gave rise to a lengthy and unprofitable discussion, failed to explain the closure of both ends of the loop, a circumstance which is generally deemed essential in strangulation. The elaborate works of Meyer and Reichel contain in full the particulars which show that these theories are untenable.

Kocher's "Distension Theory."—Kocher, again, brought forward a different interpretation. He thought that in fæcal occlusion both ends of the loop were closed at the outset, and that the course of events was about as follows. By intra-abdominal pressure or by peristalsis a loop of gut in a hernia receives suddenly a charge of intestinal fluids. The loop is thus distended, and thereby more bowel is drawn into the sac from the lower (exporting) end. In consequence of the entry of fresh mesentery along with the gut, the ring is virtually made more narrow. Kocher leaves unexplained the mechanism by which he accounts for the closure

* Busch first put forth this theory in 1863.

of the upper (importing) end of the loop, for though he takes great pains to elaborate his "theory of stretching" in the early part of his work, he does not explain very clearly its application when he comes to the consideration of fæcal occlusion. Kocher finds "the actual difference between fæcal occlusion and elastic strangulation to consist in this, that, with the former, the protruded loop is filled with intestinal contents, and is, on account of the filling, irreducible, whereas in elastic strangulation the loop is empty, and is irreducible on account of the tight grasp of the stricture."[19]

Reichel's Theory. Reichel gives a somewhat different description of the mechanism of "Kotheinklemmung." He starts with the postulate that the ring shall be sufficiently narrow, before the entry of fluid, to keep the walls of the intestinal tube in contact, though not necessarily pressed together.[20] Then, by intra-abdominal pressure or by peristalsis, some of the intestinal contents are suddenly forced into a loop of gut which is already protruded, or which descends with its contents. The loop is distended and draws in more bowel and mesentery from the lower (exporting) end, so that the area of the ring is quite filled up. Inasmuch as the inrush of fluid causes more bowel to be added to the loop, the latter is not tightly filled; or, as another alternative, the intra-abdominal pressure, which causes the intestinal contents to descend, causes also the intestine itself to descend, so that the loop may be only partly filled. In Reichel's fæcal occlusion the ring is, at first, wide enough to let intestinal contents together with the bowel pass through, and, secondarily, becomes too narrow by the addition of mesentery. The effect of peristalsis above the hernia will be to accumulate gradually (for the peristaltic action is not continuous) the intestinal fluids and gases in the bowel above the ring. This dilatation of the importing bowel occurs in elastic strangulation in a manner exactly similar. If taxis is attempted, the increased pressure in the loop will tend to cause more bowel and mesentery to enter the sac from the lower end, and to make the closure more firm, as in Röser's experiment.

Difficulty of Distinguishing Elastic Strangulation from Fæcal Occlusion.—It is evident that, in practice, it is scarcely possible to detect a case of "fæcal occlusion," for very few opportunities occur, either in the living or dead, of ascertaining the nature of the contents of a strangulated loop. Borrggreve, in 1853, instituted some strangulation experiments on living animals, and found the loops distended by effusion without admixture with alimentary matters.[21] During the operation of herniotomy it is seldom that circumstances require that the loop should be opened. In several cases of this kind, where gangrenous parts have been cut away, the contents of the gut were not the ordinary intestinal fluids, but the products of effusion. Yet it is of little consequence, as

a proof of the mode of origin of the strangulation, whether the bowel contains alimentary fluids or not. The presence of such fluids may be accounted for, either because the intestine in the sac contained them before strangulation was established, or because the intra-abdominal pressure which drove them down at the same time protruded the bowel itself. Intestinal matters, therefore, may be found in a loop, even though it is the subject of elastic strangulation.

By means of a long argument, assisted by experiments on living animals and by clinical cases, Reichel arrived at the conclusion that actual strangulation is only possible when the parts in the ring fill it completely, that is, when the walls of the bowel at both ends of the loop are in contact. After the appearance of Reichel's work, Emmert drew attention to a previous dissertation of Meyer's, in which the latter had examined the whole subject of strangulation and had refuted, by the aid of experiments, the theories of fæcal occlusion above alluded to.[22] Meyer came to the conclusion, in agreement with Bidder, that "the narrowness or narrowing of the hernial orifice, and consequently the compression of the two tubes in that orifice, produces strangulation.

The Degree of Narrowing of the Bowel requisite for Strangulation.—The arrest of the intestinal stream by an obstacle something less than a tight constriction of the gut having been recognised, Meyer sought to determine what amount of narrowing of the bowel was necessary to cause obstruction. His results varied, in this respect, according to the width of the gut, the thickness of its walls, and the nature of its contents; but generally the diminution of the calibre of the bowel up to the size of a No. 10 catheter always produced complete stoppage. When the bowel was reduced to a diameter of a No. 12 catheter the intestinal stream was interrupted, but not so constantly as with No. 10 catheter, so that Meyer concluded that the conditions for strangulation are present when the space between the hernial orifice and the empty gut has been diminished to the diameter of a No. 12 catheter.

Difference in the Degrees of the Circulatory Disturbances.—As, therefore, the passage of the contents of the bowel may be prevented, though its walls are not closely compressed, a difference is observable in cases of strangulation in the degree of the disturbance of the circulation in the loop. The constriction of the gut, when strangulated, may be so tight that not only is the gut irreducible and closed to the passage of intestinal contents, but the circulation in its walls is impeded or altogether suspended. An effusion of fluid takes place into the sac and into the lumen of the loop, the coats of the latter become swollen, œdematous, and inflamed, and if the stricture is not relieved, the part becomes gangrenous. But in some cases the strangulation may last for several days, and at length the bowel is found to have suffered only slightly in

its circulation. This occasional immunity is explained by Meyer's observation. Shortly before his publication, Kocher had shown, in numerous experiments, that complete closure of the bowel and irreducibility may take place without any trace being discovered of a mechanical disturbance of circulation in the loop.[23] Reichel has corroborated this statement.[24]

Uncertainty regarding Fæcal Occlusion.—If a strangulation, determined by the entry of fluids into a protruded loop, is not altogether supposititious, enough has been said to show that there is no strict limit between it and elastic strangulation; and as the term applied to it, viz., "fæcal occlusion," "Kotheinklemmung," raises a distinction of no practical utility, it will not be again employed in the following pages.

Strangulation by Volvulus of the Loop.—There are two other theories which differ so much from those previously considered that they require a separate notice. One of them attributes strangulation to volvulus of the protruded gut. This idea originated with Gatinaria,[25] and was adopted by Pigray.[26] Richter mentions it, but independently of his predecessors apparently.[27] It has recently been revived by Karpetschenko.[28]

Berger's Theory.—M. P. Berger supposed that the recoil of the mesentery, after protrusion of intestine, might cause closure of the parts in the ring.[29] The mesentery of the bowel in the sac may be considered as fan-shaped with the narrow end towards the abdomen. If, after the bowel descends, the mesentery is drawn up, Berger thought that it would form a conical plug entering the distal side of the ring, and occluding it. If this were so, there would be tension of the mesentery which would be discovered during herniotomy. But, after the stricture has been divided in the operation, the bowel can be almost invariably drawn further down without resistance.

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CHAPTER XXXV.

ON THE PATHOLOGICAL EFFECTS OF STRANGULATION.

The Effects of Strangulation are observed in the coverings of the protruded parts, in those parts themselves, and in the general peritoneal cavity. Before describing these effects, it will be convenient to treat of the agent by which the bowel is compressed, *i.e.*, of the part which constitutes the stricture.

The Stricture.—This must be the narrowest portion of the sac, and is such that, when it is divided, strangulation is at an end. Many surgeons in the last century, including Richter, held the opinion that the

external ring is the seat of stricture in inguinal hernia. Hence arose Petit's operation for relieving strangulation without opening the sac.

The Stricture by the External Ring was limited by Sir Astley Cooper to cases of old and large herniæ. In these the two rings and the neck of the sac nearly coincide, and the same incision would divide them all. The observation, made by Le Dran[1] and others, of cases in which a rupture had been pushed back into the abdomen with the bowel still in the grasp of the mouth of the sac (réduction en masse), proved that in these instances the stricture was formed by the neck of the sac.* Pott, who disbelieved "réduction en masse," was very well aware that the stricture might be made by the sac in ordinary hernia as well as in that which occupies the tunica vaginalis.[2] Scarpa afterwards laboured to show that the stricture resides most commonly in the neck of the sac, and Dupuytren devoted a complete essay to prove the same proposition.†[3]

Stricture by the Neck of the Sac. - The principal argument of the latter surgeon was drawn from the facts observed in "réduction en masse," which prove without doubt that the stricture in such cases is at the neck of the sac. This is equally true of inguinal and of femoral hernia. Dupuytren explained the preliminary contraction of the neck of the sac according to the old formula, which runs as follows—"The application of a truss presses together and contracts the neck of the sac, even inflames it, as well as the tissues outside of it; whence comes about a narrowing of the orifice and a thickening of the parts around the neck which gives it a power of great resistance." Malgaigne, who held the same opinion as Dupuytren, furnished the additional argument that if the external ring is the seat of stricture, the spermatic cord, as well as the sac, must suffer compression; but it does not so suffer. Therefore the stricture is at the neck of the sac.

On the other hand, M. Paul Berger examined a considerable number of herniæ of different sizes, and dissected in each instance the neck and "all that part of the peritoneum by which it is encompassed."[4] He found that "the most rigid necks, and those apparently least capable of dilatation, became much wider and more extensible when they were separated from their connections with the fibrous rings through which they passed." Berger came to the conclusion that "the neck in itself,

* Saviard appears to have first noticed strangulation at the neck of the sac in the corpse of a woman upon whom herniotomy had been performed by another surgeon. The sac had been isolated and reduced with bowel still strangulated in the neck. (Obs. de Chir., 1702, vol. xix. p. 99, quoted by A. Bardeleben, Lehrb. d. Chir. u oper. Lehre, 1872, vol. iii. p. 764.)

† According to Morton, Baron Dupuytren was accustomed to express the opinion that in nine of every ten cases of strangulated hernia the stricture was at the neck of the sac. (Lond. Med. Gaz., 1840, vol. xxvi. p. 31.)

isolated from all its relations, is very rarely capable of forming the veritable stricture." In that large class of herniæ, wherein the viscera occupy the tunica vaginalis or a part of it, the stricture very commonly is caused by the neck of the sac. Not only is that orifice usually very narrow, but in sacs of this nature Ramonède found, in the adult, sharp-edged bars and bands at the mouth of the tunica vaginalis which afforded an explanation of the severity of the symptoms and of the lesions so notorious in such cases.

Seat of Stricture in Inguinal and Femoral Hernia.—It is probable that the seat of the stricture is more often at the neck of the sac in inguinal hernia when all the varieties are taken together, and at the fibrous ring (Gimbernat's ligament) outside the neck in femoral hernia. Before the introduction of antiseptic surgery, Petit's operation for the relief of strangulation, in which the sac is not opened, was frequently practised, and if the statistics of that operation are compared with those of the operation in which the sac was opened, a rough estimate is obtained of the frequency of stricture inside and outside the sac; for it is evident that if the hernia was reduced without opening the sac, the obstacle to reduction could not be in the neck. The statistics given by Mr. Bryant in his Clinical Surgery serve very well for the present purpose.[5] In 44 inguinal herniotomies the sac was not opened in 20 per cent., and in 104 femoral operations it was not opened in 43 per cent. These statistics, as applied to the present question, are vitiated by the fact that the opening of the sac was sometimes determined, not by the difficulty of reduction, but by the duration of the strangulation or by other considerations; but, setting this objection aside, the result is that both in inguinal and in femoral hernia the obstacle to reduction is more often in the sac than outside it,* and much more so in inguinal than in femoral hernia. It will not be necessary to recapitulate the various unusual forms of the stricture which have been mentioned in Chaps. XIII., XIV., and XV. as arising from anomalies in the construction of the sac, or from an unusual arrangement of adhesions or of the viscera, but I will now pass to the consideration of the effects of strangulation upon the sac and its contents.

Effects of Strangulation—Lesions due to Taxis.—It must be premised, however, that the lesions found in many cases are twofold, being the result, partly, of the surgeon's or the patient's attempts at reduction, and, partly, of the constriction of the protruded viscera. Consequently, though the integuments over a strangulated hernia are, as a rule, unchanged, they may show traces of violence, and be ecchymosed or reddened.

Rupture of the Sac.—The pressure to which the bowel or omentum

* In the sac wall is here meant.

is subjected at the stricture, hinders the circulation in these parts, and causes a transudation of serum into the sac. I have found the sac burst from previous taxis, and this fluid effused into the surrounding tissues. Not unfrequently the serum is bloodstained as the result of taxis, though this admixture of blood may be due to another cause. In rare instances the sac may be rent so extensively that the intestine as well as the serum are found outside beneath the skin.* This is probably always the result of external violence; but it has been supposed that the sac, in sundry cases, has given way before the action of intra-abdominal pressure. Of this the evidence appears to me to be by no means conclusive.

It is probable that the wall of a sac which bursts under taxis, has participated in the changes which the contents undergo, and is weakened by inflammation. Among a very large number of irreducible (non-strangulated) herniæ, to which taxis has been applied by my colleagues, at the Truss Society, or by myself, I have never known the sac to give way, though great force has often been used in attempting reduction.†

Injuries to the Bowel.—I have occasionally seen blood clots lying free upon the surface of the bowel in the sac. The gut has been found encased in blood clot,[6] or bathed in dark blood having the consistence of treacle.[7] Sometimes the bowel itself is severely bruised and engorged with blood, and this would be more frequently seen, were it not that the fluid in the sac protects it in some measure from violence. The injury to the wall of the intestine may be so extreme that blood is effused into its lumen or into the abdomen, or into both these cavities.

A man, æt. 79, was subjected to prolonged taxis by Broca, by which the hernia was at length reduced. Next day there was a slight escape of blood from the anus, which recurred at 2 P.M., after which he became blanched, and soon died. The abdominal cavity contained 350 grammes of liquid blood, which was also present in the sac and in the interior of the bowel. A tract of intestine 60 centimetres in length was deep violet and engorged with blood, but there was no obvious perforation of its walls.‡

Small lacerations of the serous tunic from taxis are not uncommon. Macfarlane has given an instance which shows very well the extent of the injuries which may be caused by imprudent and prolonged taxis.

* A good example of this effect of violence is given by Bidder, Arch. f. klin. Chir., 1875, vol. xviii. p. 28.

† That the sac sometimes gives way when in its ordinary condition, is shown by the cases in which it is ruptured by blows or crushing.

‡ Three cases in Table XXXI., which had been subjected to much taxis, had bloody stools after the operation, one patient passing as much as a gallon of blood from the rectum. Similar observations have been recorded by Mr. Hulke, Med. Chir. Tr., 1866, vol. xlix. p. 189; and Mr. Kough, Lancet, 1884, vol. ii. p. 636.

A man, æt. 39, whose hernia was strangulated for ten hours, was subjected to taxis for the greater part of that time. On his admission to the Infirmary attempts were made again to return the parts. The scrotum was much swollen and discoloured. The sac contained one and a half pounds of blood, and coagulated blood covered the omentum and intestine in the hernia. The omentum, moreover, was bruised and lacerated, whilst the gut was almost wholly separated from its mesentery. Several rents in the mesentery ran in a longitudinal direction, and into each of these two or three fingers could be introduced.* In other cases the bowel is burst in the sac, where it remains unreduced, or the escape of its contents permits its return to the abdomen, of which the consequences are fatal.

Lesions of the Coverings due to Inflammation.—Except as a result of injury, the coverings of a hernia undergo no appreciable change, as a rule, in strangulation. An inflammation of the contents of the sac is sometimes disclosed by œdema of its coverings and redness of the skin, but these symptoms may be caused by taxis, and thus they give no constant indication of the condition of the parts beneath. Inflammation may produce considerable thickening of the sac wall, especially in femoral hernia.

The coverings of a hernia in exceptional cases may be infiltrated with pus, and when strangulation has destroyed the vitality of the protruded viscera, they may participate in the gangrene of the deeper parts. The skin then inflames, becomes purple, greenish, and afterwards black. Emphysema develops in the subjacent layers. Blebs form, and the eschar at length separates, setting free a fœtid ichor, which may be mingled with fæces. The occurrence of emphysema between the skin and the sac does not by itself necessarily indicate the advent of gangrene. Professor Albert cites a case from Dieffenbach in which a femoral hernia had been strangulated for twenty-four hours, and the incision at the operation liberated bubbles of gas with a crackling noise, though no gangrene was present in the sac.[9] Kocher operated on a patient in whom the sac was gangrenous, but the bowel was not.[10] The intestine is not infrequently mortified without any notable change at the surface. Though gangrene of the integuments indicates, as a rule, the condition of the deeper parts, the absence of that sign is no proof of the integrity of the hernial contents.

Lesions of the Contents of the Sac—Fluid in the Sac.—The pressure exerted at the seat of stricture disturbs the circulation in the protruded parts, and produces in them various pathological changes. If the stricture is not very tight, the venous circulation alone may be impeded,

* The case is quoted from the Clin. Rep. Glasgow Infirmary by Teale, Pr. Tr. Abd. Her., 1846, p. 96.

and this, only to such a degree, as to cause a transudation of serum into the sac. If the venous stream is further obstructed, whilst that in the arteries flows on, there will be a migration of red corpuscles, and the effusion will be more or less bloodstained. Hence Reichel supposed that the amount and constitution of the fluid in the sac indicated the extent of the disturbances of the circulation, and consequently the grade of compression at the ring.[11] But as the admixture of blood may be due to taxis, this inference is not admissible in the majority of cases. The quantity of the fluid was thought by Sir Astley Cooper to be in proportion to the amount of intestine strangulated, but this rule does not hold universally, any more than his succeeding one, which lays down that omental herniæ have no fluid, or very little in the sac. The fluid may be a clear serum, or it may be more or less deeply tinged with blood. It may be muddy in colour, or blackish, even though gangrene is not present.*[12] As the protruded parts are often inflamed, the fluid contents of the sac in such cases have the characters of inflammatory effusion. It is then a sero-fibrinous, a sero-purulent, or a purulent effusion. It may be merely fibrinous, or may be absent altogether, in which case the gut or omentum is in contact with the sac wall.† Fluid is absent in about one case in three.‡

If the stricture is so tight that the arterial and venous streams in the protruded parts are both immediately and completely stopped, there will be no fluid in the sac, and therefore the absence of fluid might be taken as a very ominous sign. But it is not so, for its absence by no means indicates a total suspension of the circulation in the loop. Among seven cases in which the sac contained no fluid, I found in one only ulceration of the gut: in the other cases the bowel had suffered so little that it could be returned. The complete stoppage of the circulation in the protrusion generally comes about gradually, and it is extremely rare to find the bowel so severely pinched that it cannot pour out any fluid into the sac. The absence of fluid must be owing in general to some other cause. In rare instances fluid has been collected at the back of the sac in consequence of adhesions between the viscera and the front of the sac. When gangrene has occurred, the fluid emits an offensive odour, is turbid, and of a reddish brown, dark brown, or coffee ground colour. It has often been described as a fœtid sanies. The foul odour is not in itself a sign of gangrene, as the fluid at times has this peculiarity though the gut is still capable of recovery. Hoin found in this liquid drops of oil set free from the gangrenous omentum.[13] In cases in which

* Goyrand met with a case of strangulated umbilical hernia in which the serum was blackish though the gut was sound. (Presse Méd., 1837, No. 23.)

† This is the "dry hernia" of Petit.

‡ In 64 cases of strangulation, fluid was absent in 33.3 per cent.

the bowel has given way, the fluid may be mixed with the contents of the intestine, and have a more or less yellow colour and turbid appearance.*

Lesions of the Omentum.—The omentum usually undergoes little change from the effects of the stricture, though it may be variously altered by previous long residence in the sac. If it has been recently much compressed at the ring, it is of a deeper colour than normal, and of denser texture. When it is so severely strictured as to lose its vitality, it may be dark red or livid, and if divided, no bleeding follows the incision. In other cases it presents the appearance of a dirty slough.

The omentum has been found so little perceptibly changed, that it has been returned, yet after a few days has been cast off as a slough, or been found gangrenous after death.[16] When a hernia mortifies, the bowel usually suffers first, and it is very rare to find the omentum gangrenous and the bowel sound. Johnston recorded a case of femoral hernia which illustrates this exceptional circumstance. The operation had been deferred by the patient to the thirteenth day, when the omentum was fœtid and gangrenous, whilst the bowel, which it completely enveloped, was in good condition.[17] Gangrene of the omentum in the sac appears to have a tendency to spread to that retained in the abdomen. The same thing is noticed in the bowel, in which gangrene may extend from the part contained in the sac, or appear simultaneously in the sac and the abdomen, but the causes of this are much more evident than in the case of the omentum, though the latter seems to be more liable to the accident. Finally, it may be said, that, when the parts in a hernia have been injured by constriction, the bowel not only suffers first, but, as a rule, suffers most. If it is rare to find the bowel ulcerated or gangrenous, it is still more rare, as M. Gosselin has pointed out,[18] to see the omentum participating in those lesions.

* The condition of the fluid in the sac has been investigated by Nepven and Garrè to determine whether it contains bacteria, and under what circumstances. The conclusions of Garrè are as follows. The fluid in the sac of non-strangulated hernia is absolutely sterile. The analysis of eight cases of strangulated hernia shows that the occurrence of bacteria is not dependent on the shorter or longer duration of strangulation, nor is there a constant relation between their presence and foully smelling fluid. In cases where the gut has lost its vitality and is gangrenous, bacteria wander through the wall of the gut and may produce a fatal "peritonitis bacterica."[14] M. Clado carried the investigation somewhat further, and performed inoculation experiments with the fluid taken from the sac of a strangulated hernia which had proved fatal. The bacteria, found in the hernial fluid, were detected in the blood, in the spleen and lungs, and in the serous cavities of the animals subjected to experiment. When a cultivation, that had been kept at a temperature of 28° C., was used, the injection was not fatal, but when the temperature had been 37° C., the animal died. M. Clado supposed that the cause of death in strangulated hernia was the introduction of bacteria from the intestinal tract into the organism.[15]

The Changes observed in the Intestine are usually arranged under four heads—(1) Congestion; (2) inflammation; (3) ulceration; (4) gangrene.

Lesions from Congestion.—When congested, the bowel still preserves its lustre, but its substance is thickened by œdematous effusion, and it is altered in colour. If the circulation is only slightly impeded, the bowel has a bluish colour, like that of a varicose vein. The vessels in its wall are still discernible and loaded with blood. With a greater degree of obstruction to the circulation the individual vessels will be less easily seen, and the colour of the gut will range from a reddish blue to reddish brown, chocolate, port wine colour, or even black. There is ample evidence that portions of gut which have presented one or other of the darker shades of colour have been replaced in the abdomen during the operation of herniotomy and have lived. Pelletan returned a bowel, which had been strangulated for six days; it was already black, but still shining, and the patient made a good recovery.[19] Many other instances of a similar kind are on record. The darkness of its colour does not indicate that an intestine has mortified. If uncertainty is felt, there are three signs by which its vitality is made manifest. Firstly, the lustre of the serous coat persists; secondly, when the bowel is stroked, the vessels may be emptied and seen to refill; thirdly, the intestine may be pricked and will bleed, if still living.* The first of these signs is the least important, because it often happens that inflammation affects the serous coat, whereby its lustre is dimmed, though the vitality of the loop is not destroyed.

When the colour of the intestine is very dark, it is due, in some cases at least, to extravasation of blood into the subserous and submucous tissues. The engorgement of the loop may be so extreme that, though it is not gangrenous, it does not recover its function. In a case of this kind, under Baron Dupuytren, which is quoted by Lawrence, the intestine was of an ebony black colour, though, at the same time, firm and not friable. After reduction, death occurred from acute peritonitis, and the loop, lying free in the belly, was found unchanged. In fatal cases this loss of function is not confined to the loop which has been strangled, but affects a certain length of the bowel above the stricture, as will be more particularly described hereafter.

It cannot be decided to what extent the discoloration of the protruded parts is due to the stricture or to the taxis. Probably it is in some measure caused by the latter agency. Mr. Birkett observed for many years the state of the bowel after death from strangulation, to ascertain how far the lesions were due to violence, and how far to the

* Pricking the surface of the gut to test its vitality was suggested by Sir Charles Bell. (Institutes of Surg., 1838, vol. ii. p. 43.)

constriction. He states very emphatically the opinion that the damage done by the strangulation is in no way comparable to that caused by the hand of man, and he furthermore asserts that "in all the instances in which the entire bulk of the herniated bowel was in a state of sphacelus, that condition was the result of violent, protracted, and ill-applied manipulation." [20]

A case of femoral hernia once came under my care which had been strangulated for five days, and during all that period the symptoms were acute. The patient had escaped without any attempt at taxis, and, when the bowel was exposed, it was little altered in colour, though swollen and deeply grooved along the line of pressure.

But it has been proved by experiments on animals that a constriction of the intestine, if not very tight, causes it to assume a dark violet or black colour. Jobert ligatured the intestine in dogs, so as not to arrest the arterial stream, but to impede that in the veins, and he found the gut swollen to twice or three times its normal thickness, perfectly black, and having in its cavity, and between the layers of its coats, dark blood. The serous membrane was here and there raised by small accumulations of blood between itself and the muscular coat.[21] If the animal was left to its fate, the congestion increased till the arterial stream was stopped, and the part became gangrenous. According to Nicaise, it is rare, in experiments on animals, to find blood in the interior of the loop, and it is still more rare in man.[22]

The Contents of a Strangulated Loop are, as a rule, "a pale yellowish, pellucid, thin, albuminous fluid," with some gas, and without other intestinal matters. Occasionally, however, it is otherwise. Nicaise obtained from Vollemier the account of a case in which the surgeon had opened the bowel, mistaking its dark colour for gangrene, and found within it black clots.* The fluid is not unfrequently bloodstained.

Lesions from Inflammation.—In a certain proportion of cases the injury to the bowel from the strangulation not only interrupts the circulation, but produces inflammation in its walls. The protruded part is affected with a peritonitis, of which the appearances are somewhat modified by the congestion present at the same time. The surface of the bowel may be covered by a thin layer of coagulated fibrine, like a delicate membrane, or the effusion may be in greater quantity. It has been seen so thick as completely to conceal the intestine. Cæsar Hawkins, on opening the sac of a strangulated inguinal hernia in a Frenchman, whose age was 107, met with a mass of transparent jelly, as it seemed, which was a quantity of recent lymph infiltrated with serum.[23] The inflamed intestine, when brought into view, may be of a somewhat florid red, if the stricture is not tight, but generally it is of a dark

* Nicaise also quotes a similar case from Voisin.

colour from congestion. The surface is cloudy from loss of endothelium, and has a velvety appearance.

A most important circumstance, in connection with inflammation of the loop, is the effusion which may unite the bowel to the sac, or one part of the bowel to another. Recent adhesions are easily broken down, and it is of great importance that this should be done before reduction; for by neglect of this precaution it has happened, that a loop has been replaced in the abdomen with the two limbs still adhering by their adjacent surfaces. The bowel, thus fixed and bent upon itself at a sharp angle, may be impermeable, and occasion a fatal obstruction.[24]

A more extensive inflammation, which involves all the layers of the intestinal wall, has been termed parenchymatous by Broca. It was noticed by Jobert that inflammatory products were sometimes disposed between the tunics of the bowel, and these exudations may be simply fibrinous, or, in more severe cases, purulent. But the principal effects of the parenchymatous inflammation are seen in the mucous and submucous tissues. The mucous membrane is swollen, highly injected, and often presents whitish or yellowish-white streaks and patches resembling diphtheritic membranes. These plaques, when raised, are found to conceal a loss of substance. The ulcerated spots may have a sloping edge, or a swollen sharply cut margin. Ulcers at the middle of a loop are thought to be rare, whilst those at the line of stricture, due to pressure, are sufficiently common.

The results of an Histological Examination of the Bowel in hernia have been described by Cornil and Tchistowitch from preparations supplied by Kirmisson, Chaput, and Rochard. It is somewhat to be regretted that they have not specified more exactly the part of the bowel to which the description applies.

"The lesions," they say, "attack especially the mucous and submucous tissues. In a section taken from a swollen part, no villus nor gland was remaining. The muscular tissue of the mucous membrane stopped short near the highest part of the plaque, so that the thickened area is formed solely by the cellulo-vascular tunic. The vessels in it are greatly distended by blood and fibrine. In the interspaces of the vessels one sees red corpuscles, leucocytes, and fibrine, forming together that kind of false membrane above referred to." By using Weigert's method of staining, they could see a distinct and close network infiltrating the whole layer. The transverse and longitudinal muscular layers were little injured. In them the vessels were distended, and sometimes interstitial hæmorrhages were found, and some migratory cells. Under a higher power they saw numerous migratory cells about the vessels, still capable of taking the stain, by which an inflammatory process was recognised. In the reticulated connective tissue of the portions of the

submucous layer still remaining, many lymphatic cells were granular, hyaline, and necrosed. They thus detected an inflammatory and a necrotic process attacking at the same time the mucous membrane, a process which gave origin to the pseudo-membranes. These are not superadded to the mucous membrane, but are only mortified areas, in course of elimination.[25]

Condition of the Loop.—The bowel in a strangulated hernia, whether congested or inflamed, is full and tense. This is due, partly, to the exudation of fluid into its interior. In cases in which the loop has been opened on account of gangrene or tapped to diminish its size, the contents have been principally a mucous, sanguinolent fluid. Gas may be mixed with it, but very rarely the products of digestion.[26]

The Tension of the Loop is due to effusion of fluid into its cavity, but the size is also increased by infiltration into its coats. Reichel, in his strangulation experiments, after he had withdrawn the contents of a loop, often found it completely irreducible from thickening of its walls.[27] Labbé placed a ligature round a loop of intestine in a terrier dog. Before the operation the loop displaced 71 cubic centimetres of water and nineteen hours afterwards 199 cubic centimetres.[28] The enlargement of the coats of the intestine sometimes attains a great size in hernia. Nussbaum mentions "enormous swelling" of the protruded loops in a strangulated inguinal hernia on which he operated.[29] Some observers state that they have found the strangulated bowel, when not mortified, empty and lax. Collapse of the gut is one of the most constant and important signs of gangrene, but under other circumstances is altogether exceptional.*

Lesions at the Seat of Stricture.—Before proceeding to the subject of gangrene, it is necessary to describe the effect upon the bowel of the pressure at the seat of stricture. When the intestine has been released and drawn down for inspection, it presents an indentation or furrow corresponding to the line of strangulation. This furrow may be circular and extend all around the part that has been constricted, but much more often it consists of a segment of a circle. The depth of the groove appears to be greater than it really is on account of the swelling of the parts on each side of it. When the tissues of the gut have not suffered solution of continuity, the furrow, after exposure, becomes perceptibly less, and if the bowel is stroked, as Velpeau recommended, it may entirely disappear. In some instances, however, it persists, and if the gut is returned in this condition, it may be found after death unchanged.

* Kocher states that in nineteen observations he found the loop ten times quite or almost empty, six times easily compressible, and three times tense or strongly distended. Benno Schmidt quotes a case of Günther's and one of Linhart's in which the loop was quite empty at the operation.[30]

Jobert quotes a fatal case from Ritsch in which a piece of the ileum, that had been reduced during herniotomy, was so narrowed at the line of stricture that it looked as if it were tied with a string, and it resisted the passage of the intestinal contents.[31] This is probably an extreme case, but Palesciano supposed that they are not very rare, and suggested that the calibre of the tube should be restored by drawing down the gut and invaginating the part above the constriction into the part below, whereby the narrowed portion would be dilated.[32] This is all the more necessary in those cases where the bowel, whilst grasped by the ring, is thrown into folds which become united by fibrinous exudation. Such a condition, if left unrelieved, may ultimately lead to stricture of the intestine.

Ulceration of the Gut. If the pressure at the stricture has been severe enough, or has lasted long enough, the coats of the intestine are ulcerated. The bowel is divided from within outwards, and one coat alone or all may be affected. Dupuytren is said to have been the first to notice the difference in the resistance of these tissues to pressure, and Nicaise has carefully described the order in which they perish. The mucous membrane at the line of stricture yields first, and may be ulcerated superficially or throughout its thickness. The circular muscular fibres are the next to give way, and after them the longitudinal fibres, which may afterwards retract. The strong connective tissue layers of the intestine outlive the muscular, but perish before the serous coat is cut through. When nothing is left but the peritoneal covering, the edges of the mucous and muscular coats have receded, so that if the intestine is held up to the light it is translucent at the line of stricture. It has often been observed, not without surprise, that the mucous membrane, which is so richly supplied with blood, is destroyed before the less favoured parts of the intestine. An explanation of this anomaly was given by Jobert, who supposed that a tissue so highly vascular has most need of blood, and soon perishes if its supply is limited.[33]

Partial Effect of the Stricture.—The effect of the stricture upon the bowel is not, as a rule, equal, but the damage is more severe at one part than at another. It is generally allowed that the lesions are greatest, first, at the upper, proximal end of the loop; secondly, where the bowel is in contiguity with the sharpest edge of the constricting ring, whether it be the upper or lower end of the loop.

Above the strangulated portion the bowel is overfilled and dilated; below the obstruction it is empty and collapsed. Therefore, when the loop is distended, besides the circular constriction, its lower end is pressed against the ring only on the hernial side, whereas the upper, proximal end is drawn against the ring by the distension of the in-

testine on the abdominal side as well as by that of the loop on the hernial side.

The deep impression made upon the bowel by the sharp edge of Gimbernat's ligament, and the relatively slight injury produced by the other parts of the constricting ring, is an old and familiar observation which can be demonstrated by preparations in every pathological museum. M. Chassaignac, who directed his attention particularly to this subject, remarked that "whenever strangulation was sufficiently pronounced to leave traces on the gut, these were never uniformly circular, but specially affected one portion of the pedicle of the hernia, whilst the other part of the pedicle suffered little or no hurt." The part most severely injured always corresponded to the sharpest portion of the ring.[34] But instances are occasionally seen, especially when a part only of the wall of the intestine is protruded (partial enterocele), in which the impression on the pedicle is annular, and all the constricted tissue is affected nearly equally.

In very rare instances the bowel is completely severed at the line of stricture around its whole circumference. It sometimes happens that the intestine enters the sac in such a position that the lower end of the loop is in contact with Gimbernat's ligament, and, under these circumstances, I have found it perforated, whilst the upper end of the loop, though subject to the effect of distension on two sides, has been sound.

Intestine protected by Omentum.—The intestine, when it is accompanied by omentum, is protected by it in some measure from the pressure of the ring. This is well exemplified in those cases in which the omentum completely surrounds the bowel, and, though strangulation lasts for many days, it is found in fair condition. Johnston was called to treat a man with femoral hernia who refused the operation for thirteen days, and when at length the sac was opened, the gut, although of a dark colour, was neither adherent nor inflamed, yet it was completely enveloped by omentum, which was fœtid and gangrenous. M. Trélat relates two cases which appear to belong to this category.[35] The body of the loop, when ulceration has occurred at the stricture, is much congested or inflamed, but it may happen that its circulation shows little sign of disturbance, though its ends are partially severed. Mr. A. Lane has related two interesting cases of this kind in which the bowel was "free from congestion," though the proximal end of the loop in one case, and both ends in the other, were ulcerated through all but the peritoneal tunic over a part of the circumference. Mr. Lane supposed that the space in the ring had been enlarged, and the pressure on the vessels relaxed when the division of the coats of the bowel had been accomplished.[36] The general rule above given, according to which the ulcera-

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tion proceeds from within outwards, is not invariable, for Nicaise noted a case in which the peritoneum was eroded at the line of stricture for 1 centimetre, and yet the other tunics were not invaded. He quotes a similar case of Baron Larrey's.[37]

Perforation of the Intestine. The ulceration at the site of strangulation may extend through the whole intestinal wall and cause perforation. After all the deeper coats have been cut through, the serous layer gives way, and the bowel communicates with the cavity in which it is lodged. The opening in its simplest form is very small, and may be single or multiple. Sometimes it is a mere pin-hole, a "capillary" opening, as Kader terms it, which is very difficult to detect.[38] If the ulceration is more extensive, a linear opening may be found opposite the sharpest edge of the ring. When an aperture of this kind is found at the lower as well as at the upper end of the loop, the surgeon's judgment is much exercised to determine the best mode of treatment. Sante Duce operated in the evening on a scrotal hernia that had been strangulated since the morning, and discovered two ulcerations in the gut, having the appearance of fissures. They were 10 centimetres apart, and each measured 1.5 centimetres long.[39] M. Gosselin operated upon an umbilical hernia containing two large loops of intestine, each of which was perforated at the entry of the sac at the proximal and distal end (four perforations). The destructive process may involve not only the parts in the stricture, but may cause at the same time an irregular opening in the bowel close above, or just below that line, or at all these places at once.

Extravasation of Fæces.—The contents of the gut may then escape either into the peritoneal cavity or into the sac. The inflammatory process in the bowel sets up a local plastic peritonitis which fixes the bowel above the ring to the parietes and prevents the effusion of its contents. But the action of this natural safeguard is often ineffectual, for the pressure within the dilated and overfilled intestine overpowers the resistance of the adhesions. Nevertheless extravasation occurs more often into the hernial sac than into the abdomen, for the due course of the inflammatory process is interfered with by the constriction at the ring and the congestion of the bowel, so that adhesions in the sac are either not formed, or, if formed, are less firm and less perfect.

Gangrene.—Perforation as the result of ulceration is closely allied to that due to gangrene, and the further consideration of it may therefore be included in the following remarks on the latter subject.

Gangrene of the contents of the hernial sac is originally and essentially caused by the constriction which they undergo. It is conceivable that a viscus may be driven out so forcibly through an opening too narrow for it, that its circulation is completely stopped on the recoil of

the ring. Gangrene, produced in this way, is infinitely rare in the human subject, and almost all that we know of it comes from experiments on animals. The intestine, squeezed through a narrow ring and then constricted, contains little or no blood. At first it is of a straw or slate colour, dull, flaccid, paralysed, cool, and without smell. After a time the colour becomes deeper grey or ashen, and whitish patches appear here and there; the tissue is now friable, and emits a peculiar and sickening odour. Later still the gut becomes shreddy and partially liquefies.* If the intestine were released before mortification had become manifest, the nutrition of its vessels might yet have been so altered that the loop would perish after reduction by hæmorrhagic infarction.

Causes of Gangrene.—Gangrene proceeding from a constriction so tight as to stop at once and completely the circulation in the bowel, called "primitive" by Jobert, is not that usually met with in man. Strangulation has lasted several days, as a rule, before gangrene declares itself, and it seems then to succeed to congestion or inflammation of the protruded parts. It has exercised many minds to explain the mode of production of gangrene, when the pressure on the intestine has not entirely arrested the circulation from the very first. Nor has it yet been satisfactorily determined, why, in some, gangrene is early, and in others, late; why it is now partial and now total; or why it affects the bowel concerned at different parts.

The principal factor which alters the nutrition of the bowel in strangulation, is the disturbance of the circulation in its walls. It is also probable that the contents of the gut may cause septic infection of its tissues. The circulation in the loop is hindered by the pressure on the vessels of its mesentery in the ring. If the blood stream is completely interrupted, the bowel soon becomes gangrenous, as has been so often proved experimentally by ligature, by division, or by artificial embolism of the mesenteric vessels.† But the pressure, which these vessels undergo at the pedicle of the hernia, is probably not very great. If it were so great at the outset of strangulation as to stop the circulation, the bowel would perish at once, but this is not generally the case. Lossen calculated that the blood pressure in the mesenteric veins was equal to about 3 cubic centimetres of mercury, and that in the arteries to about 10 to 12 cubic centimetres of mercury. Professor Kocher, accepting this estimate, observed that the wall of the bowel and the mesentery in the hernial ring must be subject to a pressure something less than 12 cubic centimetres of mercury. Otherwise gangrene would occur very

* This description is principally taken from Jobert.

† Gangrene from artificial embolism was obtained in the experiments of Panum (Virchow's Arch., 1864), and of Prevost and Cotard (Bull. Soc. de Biol., 1865, p. 49).

early, and he quotes his own clinical experience, to which might be added that of many others, to show that it generally does not.[40] Moreover, the gangrene would also probably involve the whole loop, which is very seldom the case.

It has been already noticed, that a strangulated bowel contains a fluid effusion, which is often so considerable, as to make the loop tense. This distension has a tendency to draw more bowel, and therefore more mesentery into the sac, whence it happens, that the ring is filled more tightly, and consequently the distension of the loop further augmented.[41] Professor Kocher was the first to point out, that distension of the intestine seriously impedes the circulation in its walls. He arrived at this by blowing up with air portions of the intestines of rabbits. These experiments have been repeated, and somewhat modified by Reichel.[42] The latter used dogs, and arranged the experiment as follows. In Experiment 27 the small intestine was tied in four places, an interval varying between 7 and 12 centimetres being left between the ligatures. Of the three portions of bowel thus isolated the first was strongly distended with water, and the third with air. After twenty-four hours the nutrition of the distended parts was so much injured that, though the gut was not actually gangrenous, it yet was probably no longer capable of recovery. Reichel concluded that a strong distension may disturb the circulation in the intestinal wall to such a degree as to lead to gangrene. At the same time he only achieved this result in the experiments by extreme distension, which never occurs suddenly in nature. After strangulation has lasted some days in the human subject, the bowel above the stricture is found greatly distended by gas and alimentary matters, but Reichel was never able to expand the bowel experimentally, without bursting, by the greatest possible pressure, to anything like the same degree. Moreover, as Kocher observed, the strangulated loop is not always tightly distended.

Why gangrene should occur so regularly in strangulation, if the bowel is not released, and yet omentum, when alone in the sac, should so seldom become mortified, is somewhat difficult to explain. The omentum is compressible and can accommodate itself easily to pressure, and it has a less delicate and less intricate structure, which may enable it to bear pressure with less resentment. Kocher, in seeking to explain the difference in the behaviour of these two organs in strangulation, concluded that the substances contained in the bowel cause septic infection of its walls.[43]

Reichel devised a beautiful experiment which demonstrates in some measure the harmful effect of contact with intestinal contents. In Experiment 21 he separated the mesentery close to the gut for a length of 4 centimetres in two places, 30 centimetres apart, and ligatured the

bowel midway between these portions. After twenty-six hours the belly was opened, and a concentrated solution of sulpho-indigotate of soda was injected into the jugular vein. The intestines were soon stained deeply blue, and at the same time peristalsis became extremely active. If that part of the bowel above the ligature, from which the mesentery was separated, be called loop *a*, and the corresponding part below the ligature loop *b*, it was observed that the middle part of loop *a*, which was about 1 centimetre in length, took no part in the peristaltic movements, but formed, with the adjacent bowel, a spindle-shaped dilatation. Loop *b*, on the other hand, underwent contractions in its whole length, though the movements at its middle part were weak. The middle part of loop *a* took none of the colouring matter, but remained of the same deep reddish blue colour that it had before the injection. At both ends of loop *a* a slight colouring with indigo was present, which faded insensibly into the deep blue of the adjacent healthy intestine. Loop *b* was stained blue in its whole extent, but in the middle part the colouring was faint.

When the intestines were removed from the body, the part above the ligature was found to be filled with thin paplike contents; its walls were œdematous, and in their whole thickness stained blue. It was only the middle portion of loop *a*, 1 centimetre in length, which was marked off on both sides by being completely without colour. On further examination it was seen that the serous membrane of loop *a* was faintly tinged by the injection, but the mucous membrane, the submucous tissue, and the muscular layers were not coloured at all. These parts, consequently, had suffered total necrosis. The gut below the ligature was quite empty, and its wall normal. The middle portion of loop *b* was marked out by its faint coloration from the deep blue of the adjacent parts, but differed from the corresponding part of loop *a*, in that it was not completely without blue stain. Section of its walls showed that the mucous membrane was likewise almost without colour, whilst the muscular and serous layers were distinctly tinged.[44]

In this experiment the upper loop *a*, which was exposed to contact with the intestinal contents, suffered most injury. Its central portion was completely paralysed, and was without staining; only single vessels in the serous layer at the convexity of the loop being injected, whilst the muscular, submucous, and mucous tunics were quite free from the colouring matter. The central necrotic part was sharply marked off from the bowel at each side, which was damaged, although still capable of living. In the lower loop, *b*, on the contrary, where no fæcal matters were present, the mucous membrane of the middle portion only was completely necrosed, whilst the muscular and serous tunics were still partly nourished, though deeply ecchymosed. Reichel points to the deleterious

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influence of the accumulation of fæcal matters on the upper loop, *a*, but leaves undetermined, whether this was due merely to distension of the tube, or to septic infection.

How far the invasion of gangrene is assisted or even caused by violence done during taxis cannot be decided, but it is the opinion of some authorities that this violence is the principal agent.

Characters of Gangrene. The dead part may be no more than a point on the intestinal wall, or may involve a portion of the circumference, or consist of the whole loop. The intestine, which has been congested and perhaps inflamed, and which therefore has a rich purple or black colour, when it mortifies, loses colour and also changes colour. At the dead part the fluids in the wall of the gut, carrying in solution the colouring matters of the blood, transude, and hence the loss of colour. The decomposition, which is soon set up, introduces various shades of brown and green, and causes the change of colour. Thus the aspect of mortified bowel is due to alterations in the quantity and composition of the colouring matters of the blood contained in its wall. "All gangrenes," as Jobert observes, "would be white, if blood did not colour the tissues." When the loss of pigment has been considerable, the bowel shows whitish patches. It is said to be marbled, or, according to one author, "piebald." Its most common hue is grey, or ashen grey, in which there may be spots of varied colour. Again it may be greenish, or greenish yellow. Whichever of these different appearances is presented, a strong contrast is always observed between the living parts and the dead. The intestine has been found after three weeks' strangulation coal black.

The serous coat loses its lustre and looks dull, but not in all cases. The loop, no longer tense, collapses, and may fall into folds. At the same time the tissues of its wall are softened, so that they give way on being handled, or, to use a well known simile, they tear like wet paper.* Moreover, the bowel has a "cadaverous," penetrating smell, and, if a considerable portion of the tube has perished, there is a sensible difference in the temperature of the living and dead parts, though the latter can hardly be called cold. The bowel, however, is not always collapsed, even when a large tract is affected, and if the process has not gone far, the walls may still be thickened from the previous congestion, and have a firm consistence. In rare instances the serous coat alone has mortified, leaving the rest of the intestine to recover. Wilmer mentions the case of a woman under the care of Mr. Alanson, whose hernia sloughed during strangulation, and the peritoneal surface of the gut came away without opening the tube itself.[45] Piéchaud operated on a man, æt. 42, on the third day of strangulation, and found the peritoneum of the loop raised from the underlying tunic by a bloodstained serum. The

* This expression was attributed by Lavater to J. D. Sala.

peritoneum burst and was completely detached, leaving bare the muscular coat. Between the muscular fibres, which here and there stood apart, little herniæ of the mucous membrane came into view.[46] Mr. W. H. Bennett describes in one of his cases "a breach of surface involving the peritoneal and muscular coats only."[47] Gangrene, however, generally destroys the whole thickness of the intestine.

Suspected Intestine.—When fully developed, the signs of gangrene are sufficiently distinct, but there is, unhappily, a class of cases in which it is hardly possible, at the time of exposure, to be sure that the bowel is living, or will continue to live. These have been called "suspected cases" by Richter, and they have often caused serious embarrassment to the surgeon. It is well known that a loop, which is only deeply congested, may, after reduction, become gangrenous, or give way, or remain without recovering its function, and in all these cases cause death. It is not uncommon, therefore, to meet with bowel which may be justly termed "suspected." No help is obtained by trying to excite peristaltic movements, for these are paralysed for the time being in strangulated hernia generally. If the bowel bleeds, when pricked, it must still be living,* but there is no positive sign that it will continue to live.

Gangrene subsequent to Reduction.—The difficulty of deciding whether the bowel is still able to recover, is occasionally so great, that the records of surgery contain a long list of cases, in which intestine, that has been returned at the operation, has subsequently mortified. Reichel has pointed out that if strangulation has arrested entirely the circulation of the loop, even for a short time, its vessels may be so much damaged, that after the bowel is liberated, a hæmorrhagic infarction of the whole piece takes place, which is apt to terminate in gangrene and perforation.[49] And thus those cases are explained in which the loop at the operation looks in tolerable condition, and yet becomes gangrenous after reduction. This catastrophe is liable to occur within the first few days after reduction, or may be delayed for one, two, or three weeks. Whenever it takes place, the consequence may be a diffuse and fatal peritonitis, which arises though the continuity of the tube be still preserved, or is set up by extravasation of the contents of the gut into the abdominal cavity. Sometimes adhesions attach the intestine to the iliac fossa and anterior abdominal wall so perfectly, that the cavity of the abdomen is closed, and the fæcal matters escape externally.

Fate of the Gangrenous Part.—The gangrenous portion itself may come away insensibly in the discharges, or be cast out in shreds, or may

* Professor Kocher says, that he found a loop of gut in a strangulated femoral hernia "empty, dull greyish-blue, and gangrenous," though it still bled when incised.[48]

even be delivered entire at the wound. There is a piece of bowel in the Museum of Guy's Hospital, 5½ inches in length, which was extruded through the wound seven days after herniotomy.[50]

When the bowel becomes gangrenous in the hernial sac, it may be found with its wall still intact, or with one or more perforations. One small area may be gangrenous which may open by separating at its edge, or by splitting in the centre so as to form a fissure. The sloughing patch may be so placed as to involve the part in the stricture together with a portion of gut above and below that line. Or the loop may present several small openings, or the whole gangrenous portion may have given way. When the process has lasted long, the bowel may consist merely of shreds. The loop occasionally preserves its tubular form, but separates completely at one or both ends. Sigismund Palm relates the case of a man with a large femoral hernia who refused operation till the tenth day. The ileum was found as black as carbon for a length of 2½ feet, and broke off at the two ends directly it was handled.[51] It has happened that a loop of bowel thus cast off has entered the lower end and been discharged per anum. Meckel quotes several cases of this kind.[52]

M. Martin records a case of femoral hernia in a woman, who, after the symptoms of strangulation had lasted for eight days, ceased to vomit and again passed stools. In this state she continued for nine days, and then died collapsed. The loop itself had perished, and the two ends of the gut opened into the sac, which was full of faecal matters. The continuity of the canal had thus been restored in an imperfect manner by means of the sac.[53]

The loop may be perforated at the middle of its convexity, which happens with especial frequency in partial enterocele. Kocher observed in his experiments and cases that the gut is more anaemic than the portion of mesentery between the two limbs of the loop. He thought, therefore, that gangrene of the apex of the loop was not due to failure of nutrition from imperfection of the circulation at the part furthest from the central blood supply, but was more probably caused by distension of the bowel, which he showed to be greatest at the convexity.[54] Dr. N. Senn has carried out some experiments in which a portion of bowel has been strangulated by a piece of broad tape or gauze. If this was kept in position long enough, the result was gangrene at the convexity of the loop.[55] This suggests that the position of the perforation is determined by the nature of the stricture.

Reichel noted in twenty-five cases the position of the gangrene, and found it at the line of constriction four times, at the convexity of the loop nine times, at both the convexity and the stricture seven times, and the whole loop gangrenous five times.[56]

Fæcal Fistula and Artificial Anus.—When perforation of the bowel

takes place, the fæces may be discharged at the site of the hernia either wholly or in part. When some of the intestinal contents follow the natural passage and a part only escape by the wound, a fæcal fistula is present. When all the alimentary matters are discharged at the wound the condition is termed Artificial Anus. The further description of these lesions will be found in Chapter XXXIX.

The Changes observed in the Mesentery in strangulated hernia, are, like those of the intestine, due partly to injury and partly to the effects of constriction.

In the first case the mesentery is swollen and ecchymosed, and blood may be effused between its layers. It has occasionally been found lacerated. Dupuy, who investigated this subject particularly, saw in the majority of his post-mortem examinations ecchymoses and subserous effusions of greater or less extent.[57]

In the second case the mesentery may show signs of congestion, and be even engorged with blood. The mesentery of the loop, as well as that with which it is connected in the abdomen, participates in the peritonitis, which is so often present, and may, in consequence, be thickened, œdematous, and charged with the products of inflammation between its layers. Its vessels are at times thrombosed.

Lesions in the Abdomen.—In describing the effects of strangulation, Lavater observes that the parts above the stricture grow red, below it they grow white, and those within the stricture grow livid. The bowel above the obstruction is filled with gas and fluids, and is kept filled by the action of peristalsis in the parts above. If strangulation continues unrelieved, this portion yields to the pressure of its contents, and reaches twice or three times its normal calibre. Mr. Bryant once found it 10 inches in circumference. In quoting one of Reichel's experiments, it was shown that the bowel only admits of distension to this great extent gradually. The effect of the distension is to cause paralysis of the muscular coat and to produce congestion, and often inflammation of its walls. The serous tunic is reddened, and the dilated blood-vessels form a rich tracery on its surface. The whole substance of the gut is thickened and œdematous, but it is said to be sometimes thinned. The mucous membrane is swollen deep red, ecchymosed, and oftentimes presents patches of more or less pale colour, like false membranes, which are "linear, circular, or irregular" in outline. Here and there the mucous membrane is eroded.

I have before alluded to the possibility of the distension of the bowel interfering to such an extent with the nutrition of its walls as to produce gangrene. In this way perhaps may be explained the occurrence of those gangrenous patches which at times are found not contiguous to, but at various points above the stricture.

The portion of bowel below the obstruction is contracted and empty. Its surface looks pale, and both internally and externally it differs, as a rule, so little from the normal, that it presents a striking contrast to the bowel above the strangulation. It is, however, congested, and not unfrequently altered in a manner similar to that of the superior bowel, and in some cases it may be affected with acute enteritis.[58] Besides the dilatation and greater or less congestion of the intestine above the stricture, there may be no other morbid changes in the abdomen in fatal cases. But very frequently strangulation sets up local or general peritonitis.

The Local Peritonitis is, for the most part, of the adhesive kind, and unites the parts of the implicated intestine to one another and to the abdominal wall. When strangulation is of long standing or great severity, plastic peritonitis commonly develops before reduction is accomplished, and, if perforation has occurred, may serve to prevent the escape of faecal matters. In rare cases, however, the peritonitis may be purulent, and give rise to an abscess in the iliac fossa, whose walls are partly formed of agglutinated coils of intestine, and whose cavity is shut off by adhesions from that of the general peritoneum. But before reduction suppuration may take place in the subperitoneal tissue above the neck of the sac, and into an abscess, thus formed, a strangulated femoral hernia was once returned "en masse" by Dieffenbach.[59]

When the Peritonitis is diffuse, it may occur before or after reduction of the hernia. It may take rise in the dilated upper bowel, which Cloquet observed to be particularly prone to this inflammation. Cornil and Tchistowitch suggest that this may be due to the retention of altered and putrefying matters.[60] The fluid in the hernial sac possesses at times a putrid odour, and Verneuil and others supposed that the reduction of this fluid, either by taxis or during the operation without opening the sac, would cause diffuse, septic peritonitis.

After the reduction of a congested or inflamed loop, peritonitis is occasionally set up by its presence. This is usually of the adhesive kind, but may be acute and general.

Despres, in 1843, suggested that the liquids in a loop, which has been strangulated, find their way by exosmosis, through the damaged intestinal wall, into the sac or into the abdominal cavity after reduction, and induce a septic peritonitis.[61] A similar explanation was given by Panas in 1867.[62] He tied up part of the intestine of a fowl till the circulation in it had ceased. He then placed the loop in a solution of cyanide of potassium, and introduced into the lumen of the tube a solution of sulphate of iron. The transudation through the intestinal wall soon produced the characteristic blue colour at the surface. This reaction could only be obtained in that part of the bowel which had been under

the ligature.* Septic peritonitis in its most severe form is seen after extravasation of the contents of the bowel into the abdomen from perforation. Under such circumstances the inflammatory lesions are generally greatest about the source of irritation, and become less and less marked towards the upper part of the abdomen.† A general septic peritonitis may take rise at the site of a perforation which is itself again closed so rapidly and so perfectly that extravasation into the peritoneal cavity is prevented. After death from strangulation the intestine has often been found in the iliac fossa still congested and marked with a furrow, and the bowel above it, still charged with fæcal matters, which it has been unable to drive forwards on account of the enduring paralysis of its walls. Cases are not infrequent of death from strangulation, both before and after liberation of the bowel, in which no trace of peritonitis has been detected in the abdomen.

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* According to M. Gosselin, it is the passage of the intestinal gases through the thinned and altered wall of the gut which sets up the peritonitis. (Leç. sur les H. Ab., 1865, p. 122.)

† Dupuytren relates the case of a young man who refused the operation, and died on the ninth day with diffuse peritonitis from perforation of the gangrenous bowel. On opening the abdomen, sero-purulent fluid flowed out, and a fœtid gas escaped, which took fire when a light was brought near, and burnt, Dupuytren says, for some minutes. (Leç. Oral., 1832, vol. i. p. 582.)

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CHAPTER XXXVI.

ON THE SYMPTOMS AND COURSE OF STRANGULATION.

The Duration of Strangulation.—Strangulation, when it is allowed to run its course, ends in one of two ways; in sloughing and discharge of the fæces at the site of the hernia, or in death. As Stoll sententiously observes, it terminates in "death of the man or in death of the part." At the present day it is seldom that a case of strangulated hernia proceeds without help from the surgeon, though his intervention often comes too late; but among obturator herniæ there are still many, which elude detection and display all the signs of unaided strangulation. From these may be learnt the duration of life, when nothing is done to set the bowel free.

In twenty-one such cases, quoted in the Chapter on Obturator Hernia, in which the whole of a loop of gut was ascertained to be included, the average duration of life was 9.2 days. One person lived only four days, and two lived as long as twenty-one days. But among herniæ in general are many instances in which strangulation has run a much more rapid course. Pirrie quotes two cases from Larrey in which only two hours elapsed between the occurrence of strangulation and the death of the patients.[1] Gibson mentions a boy of fourteen who died in twenty hours in great agony,[2] and Pelletan operated on a young man who died in twenty-one hours from the beginning of the symptoms.[3] A man, æt. 50, was admitted under Brodie to St. George's Hospital, whose hernia had entered the scrotum during an attack of asthma at four in the morning. Between nine and ten the rupture was reduced at the hospital by taxis, but the slight improvement which followed, soon gave place to signs of peritonitis, of which he died 16¼ hours from the descent of the intestine.[4] Before the introduction of chloroform patients not uncommonly preferred to die rather than undergo the operation, but such cases are now very rare, and, except in these, the duration of strangulation depends upon the will of the surgeon. The result of strangulation, however, is not entirely in the surgeon's hands, because a constriction of

the intestine, even for a few hours, as in the case last quoted, may suffice to determine a fatal peritonitis.*

Causes of Death.—The principal cause of death in strangulated hernia, whether the stricture has been relieved or not, is peritonitis. It may supervene at any period before or after reduction, and sometimes arises at the very outset of strangulation. The death, which is said to be due to gangrene or perforation, is usually brought about by means of peritonitis. Mr. Bryant found in the pre-aseptic days, that 69 per cent. of the patients died from this cause.[5]

One of the most striking features of strangulated hernia is a profound depression into which the patient is apt to fall either gradually, or without warning, and which is even more difficult to combat, than inflammation of the serous membrane. Many die in this state of collapse, and some authorities have considered it inevitably fatal. But it does not absolutely preclude the hope of recovery. It may occur in the course of strangulation at any period, and is almost constantly present when reduction has been long delayed. It may come unaccompanied by any lesion, besides that at the site of the constriction, or it may intensify the symptoms of peritonitis.

Again death may be due to septic infection from the wound, from a gangrenous bowel, or perhaps from a loop which, though not perforated, has suffered severe injury to its nutrition, and permits the transudation of fluids. Death sometimes occurs from congestion, œdema, or inflammation of the lungs. These affections are well known as complications of peritonitis, but they have been observed in cases of strangulation in which no peritonitis was discovered.† When part of the bowel has perished, and its contents have escaped by an opening at the surface, the patient frequently dies exhausted from lack of sufficient nourishment; more especially if the part involved is situated in the jejunum.

Symptoms of Strangulation.—The symptoms arising from the constriction of a loop of gut were related by Aretæus in a passage which has obtained much celebrity, and it may be questioned whether his description has ever been excelled by the gifted writers of later times in conciseness, simplicity, and truth. "In these cases" (of hernia), he says, "provided the ileus is mild, there is a twisting pain, copious

* The author operated upon a woman with strangulation of four hours' duration who was already suffering from the peritonitis of which she died.

† According to the observations of MM. Cladó, Fischer, Levy, and others, cited by M. P. Berger, these inflammations of the lung are caused by micro-organisms derived from the intestinal tube in the vicinity of the part strangulated. The bacteria are supposed to traverse the wall of the gut, and, after entering the peritoneal cavity, to be reabsorbed by the serous membrane and carried by the circulation to the various organs, lungs, spleen, kidneys, &c., in which they have been identified at the foci of inflammation."

humours in the stomach; loss of tone, languor, vacant eructations bringing no relief; borborygmi of the bowels, the flatus passing down to the anus, but not making its escape. But if the attack of ileus acquire intensity, there is a determination upwards of everything, flatus, phlegm, and bile; for they vomit all these; they are pale, cold over the whole body; much pain; respiration bad; they are affected with thirst. If they are about to die, there is cold sweat, dysuria . . . vomiting of fæces; the patients are speechless; pulse at last rare and small, but before death very small, very dense and failing."[7]

Pain.—In this description Aretæus twice mentions pain—a twisting pain, by which he indicates the severe colic or gripes so frequent at the outset of strangulation, and that later, constant pain which may merge in that of peritonitis. The griping pain in the abdomen, referred for the most part to the region of the umbilicus, is often so severe as to be almost insupportable, and produces great agitation and restlessness, but this gives place to a continuous pain, during which the patient lies still, though he is suffering severely. The continuous pain is subject to exacerbations of a griping character, which appear to be due to powerful peristaltic waves, passing along the bowel, and thus increasing the distension above the seat of obstruction. When peritonitis supervenes, its onset may be marked by increased intensity of the abdominal pain, but it is well known in this inflammation that the pain, having been acute at first, after a time becomes mitigated; or that in some instances, the lesions may reach a high grade without causing either pain or tenderness. In the majority of cases, pain, more or less acute, is present during strangulation, yet occasionally it seems to be quite insignificant. The patient, however, is often in such a condition that though he still has pain, he no longer has the power to give expression to his sufferings.

Prostration.—The "loss of tone and languor" which are noted among the early symptoms, sooner or later pass into that profound prostration which is so eloquently described by Aretæus in his closing sentences. In this state of depression the patient's features are sunken and pinched, the face dusky or ashen, the eyes dull and without lustre. A clammy sweat bedews the surface and comes out on the forehead in large drops. The extremities are livid and the nails blue. The pulse is somewhat frequent, but soft and small; it soon becomes irregular and thready, and at length is no longer felt at the wrist. The limbs and sometimes the whole body become cold.* This state has been thought

* Demarquay observed the temperature in eleven dogs in whom he had placed a ligature around a loop of gut. A marked lowering of the temperature in the first four hours was noticed in seven, whilst in four others there was a slight rise. The lowering of the temperature was more marked according as the ligature was placed higher on the digestive tube, and the repletion of the intestine had a distinct effect

to resemble in so many particulars the cold stage of cholera, that it has received from the French surgeons the name of "Cholera Herniaire."*

It is of the first importance to anticipate this depression by effecting early reduction, and to recognise the signs of its approach, for it is among the chief dangers of strangulation. It may occur within the first few hours and develop rapidly, or the patient may fail by slow degrees. At any period before reduction, and in the first few days after reduction, it may manifest itself. Before its symptoms are distinct, and whilst the pulse still has fair volume, it may render the patient calm, and thus deceive the unwary as to the peril which is imminent. A tendency to lividity of the hands and face is one of the best indications of this danger, even though the tongue be still moist and clean, and the pulse little altered in force and frequency. It occasionally develops with extraordinary rapidity, and the patient dies in a short time in collapse. A man-servant came to one of the London hospitals, recommended by his master, complaining of pain in the bowels. He was seen by a surgeon, who did not think it necessary to take him in, and he walked away. A rumour got abroad among the students that a case of rupture had been sent away. The man was followed, and brought back to the hospital at 6 P.M. At 7 P.M. the surgeon, being told that all was ready for the operation, left the patient's bedside for a few minutes, and on his return the man was dead.[9]

This prostration has by many been considered as a result of the injury and irritation inflicted upon the nerves of the strangulated part, and to be a reflex nervous phenomenon. It resembles in several particulars the collapse which accompanies injuries and some diseases of the abdomen. Peritonitis has been thought by some capable of explaining this condition, but though it frequently attends death from peritonitis, it has often had a fatal termination where no trace of inflammation was afterwards found. It has been suggested that the depression might be due to a septic infection, to an "intoxication," but it is evident that this is erroneous, because the symptoms not uncommonly pass off soon after the bowel is liberated.

Meteorism is a very variable symptom in strangulation, being often slight and often absent. If the distension of the belly is considerable, the diaphragm is pressed upwards, and the respiration is much embarrassed. This is especially apt to occur if peritonitis is present. It is a symptom of much gravity, for it indicates paralysis and over distension of part of the intestines, and this paralysis may endure so

upon the rapidity of the phenomena." M. Terrillon, however, repeated this experiment on ten dogs. In seven there was a slight rise of temperature, and in four the fall of temperature was insignificant. (Gaz. Med. de Paris, 1875, p. 29.)

* Malgaigne first used this term.

long after the bowel has been set free, that the patient gets no relief, and so dies. In cases of obstruction the late Dr. Brinton attributed the rapidity of death in great measure to the degree and rapidity of the distension.

Inability to pass Water and diminution in the amount, or in severe cases suppression of urine, not uncommonly accompanies peritonitis, but may be present independently of that complication. In strangulated hernia it is a rare symptom, and admits of the same interpretation as that diminution or suppression of urine occurring after injuries, and in some acute diseases of the abdomen. This symptom (suppression of urine) has been thought to denote perforation of the bowel, but according to Trousseau and others it is not constantly associated with that accident.*

Constipation.—The effect of strangulation is necessarily to suppress the stools, and therefore constipation is one of its cardinal symptoms. But it may be questioned whether its importance has not been overrated. When the small bowel is obstructed, it is possible to evacuate the tube below either by enemata or by the action of purgatives taken by the mouth. This action of the bowels, which can be obtained after strangulation has begun, may be quite copious, especially in that large class of persons who go several days without a stool. But over and above these cases there are some few in which the bowels act after several days of strangulation. Vinson quotes a case from Marechal in which, after complete stoppage for five days, an enema produced several evacuations. Vinson also relates a case of his own in which an abundant stool passed spontaneously on the fifth day of strangulation. Other similar instances might be quoted.

Looseness of the Bowels.—In certain rare cases strangulation has been ushered in by a copious diarrhœa, which has ceased after vomiting has begun. Wetherfield attended an old woman who showed this singularity,[10] and Vinson had a patient whose diarrhœa ceased at the end of the second day of vomiting. In other persons the looseness of the bowels is said to have lasted even longer. When fluid stools occur in a person who has fallen into a state of profound prostration, the resemblance of the case to one of cholera is very striking. Polaillon gives an excellent instance of a boy, æt. 14, who was somnolent, cold, and almost pulseless, and passed two fluid stools. He recovered after the operation.[11] When strangulation has been relieved, the patients occasionally suffer from frequent fluid stools, due, in some cases, no doubt, to the previous administration of purgatives. The occurrence

* In the condition called "cholera herniaire" Vincent has found in the urine sugar as well as albumen (Berger, *op. cit.*, p. 599). Albumen is a rare constituent in hernia.

of chylous diarrhœa after reduction is mentioned by Lavater, by whom it was attributed to an enteritis. Le Dentu has offered much the same explanation in those cases in which looseness of the bowels is present before the gut is liberated.[12] Mr. Dent observed intense enteritis, below the stricture, extending over 4 feet of intestine, in a case in which diarrhœa preceded the operation.[13] In this patient, however, part only of the calibre of the bowel was strangulated, so that the course of the intestinal contents was not completely obstructed; but as diarrhœa persisted after the gut had been set free, it is possible that the previous stools were not formed of the fluids which may have passed the stricture, but were due to the inflammation existing lower down.

Partial Enterocele.—Among herniæ called partial enterocele, constipation is not always absolute. In these a stool has been obtained so late as the fifth, seventh, tenth, and eighteenth day of strangulation. But when the bowels act it is generally in the first day or two, just as is usual when the whole calibre of the tube is intercepted. In partial enterocele about 52.1 per cent. have absolute constipation, and 47.9 have the use of the bowel to a greater or less extent.*

Desire to Stool.—It happens now and then that a patient suffers from an irresistible desire to go to stool, which he is unable to satisfy.[15] Jobert noticed this symptom in the human subject, and, moreover, observed in several experiments upon dogs, whose intestine had been ligatured near the cæcum, that they evinced a frequent and unavailing desire to defæcate.[16]

Vomiting.—The most important symptom of strangulation, when taken in conjunction with the local symptoms, is vomiting. It usually comes on very soon after the intestine has been constricted. Its early occurrence and frequency are probably related to the state of fulness, at the time, of the intestines and stomach, as well as to the shortness of the distance between the latter organ and the strangled loop.[17] In severe cases it increases as the hours go on, and all the fluids swallowed are again vomited immediately. As a rule, it continues at unequal intervals, till reduction of the bowel, or failing that, till death. It is, however, though almost always present at one time or another in the course of strangulation, subject to several variations. Sometimes it

* In 69 cases of partial enterocele, some of which have been referred to in the Chapter on Obturator Hernia, and the others at the end of this chapter, 36 had total and 33 partial constipation. Ferrier has shown that constipation is as complete in the majority of partial enteroceles as when the whole loop is strangulated.[14] Scarpa's well-known experiments corroborate these later observations. He injected water into a bowel which he had partially constricted. When two-thirds of the calibre were closed, the water passed with great difficulty: when one-third was closed there was still more or less resistance to the passage of fluid (Scarpa on Her., tr. Wishart, 1814. p. 311).

only occurs when the patient attempts to drink. It may in other cases be deferred till the second day or later. A woman under Manec did not vomit till after she was given a dose of castor oil on the fifth day. After that the sickness continued till her death on the eighth day.

Remissions in Vomiting.—If strangulation endures for some days, it is not uncommon for the vomiting to cease at one time or another. This is most usual in the last twenty-four hours of life, if the bowel has not been released, when the prostration is marked and the paralysis of the bowel considerable. But the sickness during strangulation may cease for some hours, for two or three days, and even for eight days.[18] In cases of extreme rarity it may not occur at all, though the patient suffers from nausea. These vagaries in the symptoms are most likely to occur in strangulation of the great intestine and of partial enterocele.

The vomiting probably depends upon two principal causes. That which occurs early is almost certainly a reflex nervous phenomenon, for it has been produced experimentally when the intestine was empty and prevented by section of the mesenteric nerves. The effect of an acute strangulation is to set up peristaltic movements of abnormal energy, but it is not probable that these can bring about regurgitation of the intestinal fluids and vomiting within a very short time after the beginning of constriction. Moreover, Mr. Bryant's well-known case in which vomiting occurred, though the loop of gut strangulated was below an artificial anus and therefore empty, can only be explained in this way. But the greater part of the sickness is due no doubt to the powerful peristaltic waves descending near to the seat of obstruction. This produces a regurgitation, and the upward movement of the contents of the intestine is probably assisted by the contractions of the abdominal muscles.*

Nature of the Matters Ejected.—At first the alimentary matters in the stomach are rejected, and afterwards the vomiting becomes mucous and bilious. At a period which is somewhat uncertain, but is usually the third or fourth day, the contents of the small intestine are thrown up,† and the vomiting is said to be fæcal or stercoraceous. Malgaigne used the term fæcaloid, because the odour and other characters are not those

* Dr. Brinton disposed of the hypothesis that the vomiting was due to an antiperistalsis.[19]

† Under certain circumstances the contents of the stomach, when vomited, seem to resemble stercoraceous vomiting. Doyen relates a case of strangulated umbilical hernia in which "fæcaloid" vomiting occurred the day before admission to the hospital. After death, which occurred next day, the sac was found to contain, besides a great part of the transverse and ascending colon, the pyloric extremity of the stomach and adjacent part of the duodenum. Here the only part of the alimentary canal, which could furnish the matters vomited, was the stomach.[20] It is probable, however, that this will occur only when the stomach is much dilated, or when its contents have been long retained.

of fæces, but possess a strong resemblance to them. The turbid, partly pultaceous fluid, brought up, has a strong yellow colour, like turmeric, and a very offensive odour. "Most smells want names," and this one, though it can hardly be described, when once encountered, is not readily forgotten.

Stercoraceous Vomiting is not so much related to the degree of pressure which the bowel undergoes as to its duration, and, therefore, in cases that continue unrelieved for a length of time, this symptom is seldom absent. Its occurrence has not been shown to be indicative of the severity of the lesions. It has happened that a strangulation of fourteen days' duration, which terminated in sloughing of the gut, has been, from first to last, without fæcal vomiting.

It is not only when a whole loop of bowel is closed that this symptom presents itself, for it is not uncommon in partial enterocele (40 3 per cent.). In these cases the frequency of its occurrence varies according to the nature of the hernia. It is seldom met with in inguinal, more often in femoral, and more often still in obturator hernia.* In the latter the average duration of strangulation is a little longer than in the two first.

Eructation and Hiccough.—Eructation is an early symptom, and hiccough a late one. Occasionally the vomiting, after it has lasted some time, ceases, and hiccough begins, or the two may be present together. Lavater supposed that hiccough, when it continues after operation or succeeds to it, betrays the advent of peritonitis.

The Tongue.—At the beginning of strangulation the tongue is moist, but soon becomes coated and then dry. The tongue is not always a sure guide to the condition of the patient, for it sometimes remains moist and almost clean after prostration has set in.

Fever.—The fever that accompanies strangulation is seldom of a high grade, and it is often altogether absent. When prostration comes on, the temperature may fall below normal.

Nervous Phenomena.—Before passing to the local symptoms, it is needful to mention certain nervous phenomena which have been noticed in a few instances, and have especially attracted the attention of M. Paul Berger.[22] These symptoms have been arranged by M. Berger in three groups according to their severity, and have usually been observed during the continuance of the state of prostration.

They most frequently present themselves as cramps, which may be

* In 57 cases of partial enterocele, 40.3 per cent. had fæcal vomiting. In 40 of these 57, which were inguinal and femoral, 30 per cent. had fæcal vomiting. In 53 inguinal, femoral, and ventral cases, quoted by Mr. Treves, this symptom was only present in 11.3 per cent.[21] This inequality exemplifies the uncertainty of statistical results when small numbers are taken as a basis.

continuous or remittent, and which affect chiefly the muscles of the lower limbs. M. Berger has observed these cramps to persist in at least one instance after reduction of the bowel.

In a second group of cases, even rarer than the first, the patient is seized with general convulsions. In children convulsions are so readily induced that it is not surprising that young subjects afford the most common examples of this incident in hernia, but it is not confined to them. Before the days of chloroform, patients are said to have suffered in exceptional cases during or after operations from convulsions. Montenari performed herniotomy on a boy, æt. 15, who was taken in strong convulsions lasting twenty minutes after the operation. Louis quotes a case of Du Bertrand's in which a hernia had been incised in mistake for an abscess. Whilst the operator was sewing up the two cuts in the bowel, the woman had violent convulsions.[23] In the most remarkable of M. Berger's cases the man was undergoing operation without chloroform, and after the sac was opened, had clonic, then tonic convulsions, and so died. But convulsions may occur independently of operation. Antonio Nuck watched a woman die, unrelieved, with strangulated inguinal hernia, and observed in her the occurrence of convulsions.[24] Lavater and Mauchart make formal mention of them among the symptoms of strangulation, and they have been occasionally noticed by subsequent authors.

Coma and delirium, which characterise M. Berger's third group, have been generally seen in the young. When a patient is in the state of profound prostration, so often alluded to, he is dull, but his mind is clear, and insensibility is very unusual. The cause of the nervous symptoms, above mentioned, is not well understood. They are probably dependent upon individual idiosyncrasy.

Local Symptoms.—The signs of strangulation in the rupture itself are three—pain, irreducibility, and tension.

Pain.—Pain is seldom absent. It begins at the moment of constriction, and ushers in the rest of the symptoms. It resembles that cutting, burning pain, already spoken of as common in herniæ which are not strangulated (Chap. XVI.), but it is of greater intensity. There may be remissions of the pain, which is again excited by manipulation of the tumour. Occasionally the local pain is insignificant, or is obscured by more severe pain in the belly. The rupture usually is also tender on pressure, especially at its neck, the common site of strangulation. Both these signs, pain and tenderness, though general, are not invariable.

Irreducibility.—Of all the local symptoms the most important is irreducibility. If the rupture has been heretofore reducible, and is now irreducible whilst vomiting has begun, no further sign is needed, for these are pathognomonic of strangulation. An irreducible rupture,

however, may become strangulated, in which case it is larger than before.

Tension. If a hernia is examined very soon after it is strangulated, the bowel is not tense to a marked degree, and the parts in the sac can still be distinguished. But before long the contents of the hernia are increased by fluid effused into the lumen of the bowel and into the sac. The rupture, therefore, becomes tense, and the viscera within it can no longer be felt. In the previous chapter it was pointed out that a loop of intestine might descend, and be so tightly gripped that both the arterial as well as the venous circulation in its walls would be at once suspended. In such a case no fluid would be poured out either into or around the bowel, and perhaps this is the explanation of those rare cases in which a strangulated hernia is soft and lax. But the conditions necessary for the effusion of fluid in hernia are not well understood. Sometimes no fluid is in the sac though the loop itself is tense.

Irreducible Herniæ when strangulated likewise become tense. In their ordinary condition they are not so, and can be easily recognised, but some of those in the femoral region are firm or hard, and, moreover, an irreducible hernia in any region may contain fluid, and have a tense sac. When the question lies between a strangulated and an irreducible hernia, no harm will be done to the patient, in either case, by opening the sac. The fluid in a strangulated hernia is in front of the viscera, and the sac is seldom so tense that it cannot be detected by the sense of fluctuation. When taxis is used to a strangulated hernia, if the bowel is passing back, or is about to go back, a gurgling is heard; but in a large hernia gurgling on pressure may sometimes be noticed, though the viscera remain irreducible. A strangulated hernia has no impulse on cough, and is not, as a rule, tympanitic on percussion.*

"**Masked Herniæ.**"—Up to this point strangulation has been described in which constitutional and local symptoms are present together, but there has still to be considered that rare class of cases where no tumour can be found, and the signs of obstruction exist without the hernia. These were called "masked herniæ" by the late Mr. Callender. They are, for the most part, cases of partial enterocele, but a whole loop of gut may escape detection, of which there is an example in the Museum of St. Mary's Hospital. In obturator and some of the ventral herniæ the tumour is often overlooked; and in partial enterocele in the inguinal and femoral regions the tumour sometimes cannot be felt. Mr. Treves estimated that 50 per cent. of these are "masked herniæ." It is possible that with a larger number of cases the proportion would not be quite so high, and it is likely to be less and less with the advancement of

* The results of percussion in hernia are so inconstant that it is of no value as a means of diagnosis.

surgical education. Among fifty-eight cases of partial enterocele, collected by the author, in which several of Mr. Treves' cases are included, the proportion of "masked herniæ" was 15.5 per cent. Whatever the true proportion may be, the possibility of this condition must be kept in mind, when symptoms of strangulation are present. At the site of one of the hernial orifices, if there is no tumour, there may be increased resistance, and, failing that, there may be pain; and if there is no pain, there may be tenderness. If there is positively no local indication, laparotomy has to be performed.[25]

The Signs of Gangrene.—The integument over a strangulated hernia is, as a rule, unchanged, and in very many cases the surface gives no indication as to the state of vitality of the parts beneath. It was long since established that ulceration, and even gangrene of the intestine, may exist without any previous inflammation of the skin over it. This fact has evidently a most important influence on the treatment of strangulated hernia.[26] The accession of gangrene, however, has often been signalised by a change in the symptoms, both local and constitutional, not difficult to recognise. At this period the patient is worn-out with pain and lack of sleep. He is tormented with thirst and stercoraceous vomiting. His eyes are sunken and staring, his face and whole body of a greyish hue. The limbs are icy cold, and, perhaps, covered with a cold sweat. The pulse is weak, and scarcely to be felt. The abdomen is full and distended. It is now that the surface of the tumour becomes of a dusky red colour, tending to black in the centre. On pressure the crackling of emphysema is felt in the subcutaneous tissue. The hernia, which has been tense and elastic, now shrinks, becomes soft, and perhaps undergoes spontaneous reduction. The pain ceases, and sometimes liquid stools are passed. The patient is sensible of some relief, and fondly imagines that he has begun to mend. If by reason of his strength he continues to live, the skin gives way and the fæces are discharged at the opening, but otherwise the symptoms return in all their severity, and he dies in collapse. It must not, however, be forgotten that suppuration in the sac or gangrene of the viscera may cause inflammation of the superjacent integuments before the constitutional symptoms have reached such a high grade as in the classical cases just described.

Time of Onset of Gangrene.—The time at which gangrene supervenes is variable, and is difficult to fix exactly, because, as above mentioned, it does not immediately reveal itself by changes at the surface. It has been known to occur in so short a time as four hours, and Richter saw it in eight hours. M. Berger reported a case in which 72 centimetres of intestine were gangrenous after ten hours' strangulation.[27] Generally three or more days elapse before the bowel dies. It is probable that the

tighter the constriction, the more early the gangrene; but its production is also related to the distance below the stomach of the part strangulated, as well as to the age of the patient and his constitutional state. The continuance of strangulation does not necessarily determine gangrene, though it generally does. The late Mr. Callender noted a case without gangrene after nine days of strangulation, Riecke also one after ten days and one after fourteen days, and Laboulbène one after seventeen days. But all these cases died.

Variations in severity of Symptoms.—Strangulated herniæ have often been classed as acute and chronic, or under some other subdivisions indicating variations in the severity of the symptoms. Such classification is of no practical value, and is apt to mislead by suggesting that cases with mild symptoms are of less urgency than the others.* It would not be difficult to furnish an array of cases which show that constitutional symptoms of no great intensity may be attended by lesions the most severe. Strangulated hernia of every degree admits of no delay, and there are only two cases in which the surgeon may perhaps be justified in temporising.

Strangulation in Children and in Large Herniæ.—In children a strangulated hernia can almost always be reduced, and in them the operation may often be safely postponed till a further trial has been made of the taxis. In the large herniæ of adults, when the symptoms are not very pressing, in the cases called by the French "étranglement par engouement," taxis may also be given a prolonged trial. Large herniæ can generally be reduced, and the operation upon them is so dangerous that it is by all means to be avoided.

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* There are rare instances of patients who are able to walk about and even to engage in their ordinary occupations after strangulation has begun. To these M. Gosselin especially has drawn attention.[28]

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CHAPTER XXXVII.

ON THE DIAGNOSIS OF STRANGULATED HERNIA.

Diagnosis. The symptoms of strangulated hernia are generally so numerous and so distinct that the diagnosis, as a rule, is easy. It rests mainly upon the facts that vomiting began after a hernia, heretofore reducible, became irreducible. As this last fact cannot always be substantiated, a rule has been framed, and has been taught in the schools for many years, that a swelling at one of the hernial sites whose nature cannot be determined, must be immediately explored, if accompanied by vomiting and constipation. The incision, even though futile, can do no harm, whilst, if it is not made, the patient may lose his life. But several classes of cases are met with in which not only the local but the constitutional symptoms present irregularities which make the diagnosis doubtful, and these must now be considered.

Recent Hernia. It is usual to mention in this context a rupture which at its first appearance gives rise to pain and vomiting. No difficulty attaches to such cases, if it is admitted that a hernia may be strangulated at the moment of its first formation. It was pointed out by Wilkinson King[1] that ruptures exist for many years, as a rule, before they become severely strangulated, and Mr. Bryant has verified this observation. Occasionally, however, a rupture is protruded and strangulated at the same instant.

When the Symptoms depend on a Strangulated Hernia.

Mild Constitutional Symptoms.—A hernia may be strangulated and the general or the local symptoms be ill-defined. It will not be necessary to dwell further upon the variations in the vomiting already noticed, or on its occasional absence. To show the deceptive nature of the general symptoms now and then, a case has been cited of a man who walked into hospital, and had so few signs of illness that he was dismissed by the out patient surgeon, and yet he died of strangulation the same evening. These ambulatory cases are very rare. Fano performed herniotomy on an inguinal rupture with the testis arrested outside the external ring.[2] The man walked about during the day long after strangulation had begun, but he came into hospital suffering much vague pain in the right side of the belly. Yet the abdomen was supple

and not tender. The bowels had acted a few hours before, and there was neither vomiting nor nausea. Next day he complained of constant heartburn, but had no nausea. The operation discovered strangulation of an entero-epiplocele with much fluid in the sac.

The Local Symptoms may be so slight that it may be difficult to connect them with the symptoms of obstruction. Ballingall operated on a woman, æt. 40, with an inguinal hernia strangulated for five days, accompanied by fæcal vomiting, and yet the tumour was by no means tense or inflamed, but felt flaccid, and was not particularly tender to the touch.[3] A man came under the care of Sir W. Stokes in 1874 who had had symptoms of strangulation for five days. The scrotal swelling consisted of two parts, an upper portion below the external inguinal ring, extremely tender and painful, and a lower part, in continuation with it, free from tension, pain or impulse on cough. The testis was felt below. The diagnosis lay between strangulated entero-epiplocele and an irreducible epiplocele with inflammation of the spermatic cord, and the latter supposition seemed so probable that local depletion and stupes were tried for some hours. The operation revealed that the swelling was a hernia containing omentum in large quantity, extremely congested, and concealing at the upper part of the sac a knuckle of intestine.[4] It has already been remarked that tension, pain, and tenderness may all be absent in strangulated hernia.

Omental Hernia.—A piece of omentum may be strangulated and accompanied by symptoms which cannot be distinguished from those of constricted intestine.* The sac becomes tense, and is apt to contain fluid. The nature of the parts within it can no longer be discerned by the touch. The symptoms may pass off, because the omentum accommodates itself to the pressure at the ring and loses substance. But in other cases inflammation is induced, and the protruded part suppurates or mortifies. With these accidents there is danger of the inflammation spreading to the peritoneal cavity, and therefore a strangulated omental hernia, even if it could be surely diagnosed, cannot be treated expectantly, any more than a strangulated enterocele, with which it may be so easily confounded. It is generally admitted that the symptoms to which

* Mr. Rushton Parker has contended that strangulated omentum can have no symptoms, and that cases of this nature have always a loop of bowel in addition which is reduced before the sac is explored. Against this Mr. Holmes has supported the ordinary opinion that omentum alone may be strangulated (Lancet, 1885, vol. i. p. 680). Those who have noted the contents of strangulated herniæ, differ much as to the proportion of mere omental ruptures among strangulated ruptures in general. Thus Frickhöffer gives 2.6 per cent. of omental herniæ (Med. Jahrb., Nassau, 1861, p. 427). Mr. Holmes gives 1.6 per cent. (St. George's Hosp. Rep., 1867, vol. ii. p. 311). Scholz, 1.7 per cent. (Gaz. des Hôp., 1866, p. 347). Reichel, 7.2 per cent. (Die Lehre d. Br. Einkl., 1886, p. 174). Habs, 13 per cent. (Deutsche Zeitsch. f. Chir., 1891, p. 339).

strangulated omentum gives rise are usually of less severity than when the bowel is included. The vomiting is less frequent and less copious. I was called to a woman with umbilical hernia in which omentum was strangulated, and found that she had vomited about a pint of fluid six hours previously, but had brought up nothing afterwards. In another case there was no vomiting, but only a feeling of sickness, yet the signs of depression were already evident, the tongue was dry, and the pain considerable. A piece of omentum was tightly nipped in the crural ring. If peritonitis comes on, constipation will be among the symptoms, but in the absence of this complication the bowels have often been induced to act. The omentum, like the intestine, has been replaced in the abdomen, when apparently in good condition, and has been known to mortify after its return to that cavity. This circumstance is no doubt one of those which obliges surgeons so frequently to remove the omentum at the present day during herniotomy.

Site of the Hernia uncertain.—A strangulated hernia may be present, but other conditions may intervene which tend to make its locality uncertain. The partial enteroceles in which the tumour cannot be felt or cannot be detected, "the masked herniæ," have already been considered, and require no further reference. Two herniæ may be found of which one is irreducible and the other strangulated. Kirmisson recorded a case under M. L. Championnière, in which a large irreducible umbilical hernia appears to have concealed, in some measure, a strangulated ventral hernia that passed through an opening in the linea alba three inches above the umbilical ring.[5] It has also happened that a piece of bowel has been so completely concealed by a mass of glands that it was not discovered till after death.[6] Again, an inguinal and femoral hernia, one irreducible and the other strangulated, may be adjacent to one another on the same side of the body, and the local signs of strangulation may not be distinctive. Agnew cites an instance in which symptoms of strangulation occurred in a patient with double inguinal and a femoral hernia, and each of them was irreducible. The surgeon operated on one after another, and found the strangulation in the third.[7] The local symptoms were also very misleading in a case of Nivet's.[8] An old woman who had had a left femoral rupture for two years, felt a pain in that part whilst lifting a mattress, and began to suffer symptoms of strangulation. On examination, the left hernia was not tender, but quite indolent, whereas in the right groin a small tender swelling was found in the femoral region. The operation was therefore done on the right side, where a sac containing some reddish serous fluid was opened. It communicated by a fine opening with the abdominal cavity through the crural ring. The patient died unrelieved, and a strangulated enterocele was found in the left groin which had set up

general peritonitis, and this had extended to the obsolete hernial sac on the right side, thus giving rise to a fatal misapprehension.

Obstruction from Adhesion of the Bowel.—There are rare examples of herniæ in which the bowel is not constricted, but is bent at an angle and held in that position by adhesions, so that symptoms identical with those of strangulation come on, and must be relieved in the same way by opening the sac and disengaging the loop. Professor Kocher has drawn attention to the great resistance offered to the passage of fluid along an elastic tube which is simply bent at an angle.[9] This angular bending, produced by adhesions, was well known to Rokitansky as a cause of internal strangulation,[10] and has been included by later writers among the different varieties of that malady. Adhesion and bending of the bowel in the hernial sac was described by Stephens,[11] and, since his essay appeared, has been occasionally mentioned by others.

Rotation of the Loop of Bowel on its Axis.—Some have supposed that strangulation is caused by a twisting of the loop of gut around its axis. The fact of obstruction depending upon the turning of the loop on its axis in a hernia does not appear to have been often observed. Linhart noted a case of femoral hernia in which the loop was fixed at the site of strangulation by easily separable adhesions, and was rotated on its axis, as was discovered, when the bowel was drawn down.[12] The symptoms of strangulation produced by this change of position of the intestine could not be differentiated from those of ordinary strangulation, but this is of no great importance, as in each case the treatment would be essentially the same. The possibility of the intestine being twisted as well as strangulated makes still more imperative that rule of practice to draw down the bowel during the operation of herniotomy before it is reduced.

Rotation of the Testis.—In this context that rare class of cases may be mentioned in which a testis, partially descended, undergoes rotation, so that its blood supply is interrupted, and symptoms arise somewhat resembling those of strangulated bowel. In the cases recorded by Messrs. Nash,[13] Bryant,[14] and Page,[15] this accident occurred in youths between fifteen and seventeen. The testis in two cases had not reached its normal position, and in the third its exact situation has not been specified. These testes appear to be provided with a long mesorchium, in which the twist is found just above the epididymis. All these parts are intensely congested or even gangrenous. Among the symptoms to which this form of strangulation gives rise are sickness and local symptoms. The sickness is infrequent, but, in Mr. Nash's case, was said to have been stercoraceous before admission to the hospital. The part becomes painful, tender, swollen, tense, sometimes red and œdematous. It has been pointed out by Mr. Bryant that cases formerly described as inflammation

of an ectopic testis may have been of this nature. The mode of production of the twist has not yet been satisfactorily explained.

If these cases could be certainly diagnosed, and there is scarcely anything to suggest such a condition except the absence of the testis from its normal place, it is probable that the most discreet course would be to operate and to remove the testis. Notwithstanding that even a testis gangrenous from twisting of its cord might become atrophied and shrivelled and create no danger, as Mr. Page points out, yet in some of these cases the tunica vaginalis is still patent, and therefore inflammation, set up within it, might extend to the peritoneal cavity. Such a termination would expose the patient to so much danger that an operation is certainly to be preferred, and this practice was successfully pursued by the three surgeons above referred to.

Strangulation of the Ovary and Fallopian Tube.—A hernia may be strangulated which contains, besides the bowel, an ovary or a Fallopian tube, with which may be a part of the uterus. The symptoms in such cases, which have often been designated strangulation of the ovary, &c., do not differ from those of strangulated hernia in general. In a small number of instances the ovary or Fallopian tube alone may be in the sac, and give rise to symptoms simulating those of constricted intestine. Under these circumstances the symptoms are generally entirely local, consisting of increase of the previous swelling, with tension, pain, tenderness, and sometimes with redness of the surface. The protrusion is irreducible. Among the small number of cases with the above symptoms a fraction has in addition constitutional disturbances.* There may be dragging pain in the abdomen, nausea, or vomiting and constipation. Some patients only feel sick, whilst in those with vomiting it is not frequent or severe, and is not stercoraceous. Constipation is unusual, as the bowels generally respond to purgatives. In a case fatal after operation, described by Holmes Coote, there was not only vomiting and constipation, but prostration.[17] Balleray attended a woman, æt. 37, who had long had a left inguinal protrusion. It had been reducible till four days before his visit, and the bowels had not acted for two days. There was local pain, with nausea and vomiting and sensations of faintness. The tumour was constricted across its middle, and was irreducible and tender on pressure. The operation was performed and the sac opened, from which four ounces of brownish-yellow fluid escaped. The ovary was strangulated by a band, stretching from one wall of the sac to the other, by which it had been pinched, nearly at the level of its upper third It was much congested, but was returned, and the woman recovered.[18]

* Englisch mentions twenty cases of hernia of the ovary in which symptoms of strangulation were present. Only seven were diagnosed correctly; in the remainder the nature of the hernia was not ascertained till the sac was opened at the operation.[16]

The ovary or Fallopian tube usually enters the inguinal ring, but it has also been found strangulated in a femoral sac. In the case of a woman, æt. 68, recorded by Brunner, the Fallopian tube, together with some fluid, formed the sole contents of a femoral sac. There had been no sickness, but loss of appetite, moderate pain, and distension of the belly without tenderness.[19] Mr. Owen removed a strangulated ovary which had undergone cystic degeneration, from a femoral sac. The symptoms were in this case local.[20]

Strangulation of the Appendix Vermiformis.—The appendix cæci in a hernial sac may be perforated, as occurs not unfrequently when it keeps its place in the abdomen, and local or general peritonitis may be set up. In other cases the appendix is strangulated in the same way as the ovary or Fallopian tube, and similarly the symptoms may be altogether local or more general, so as to simulate those of strangulated enterocele.

When the Appendix is perforated in a hernia, the signs may be limited to those of inflammation and suppuration of the sac, but at times constitutional symptoms are also present. Mr. Davies Colley relates a case of a boy, æt. 5 months, with a right inguinal hernia, who had suffered constipation and vomiting for three days before admission to hospital. The rupture was irreducible from the onset of the symptoms, and on examination was found in the groin, very tense and red, whilst the skin of the adjacent scrotum was inflamed, tender, and œdematous, so that the testis was concealed. No constriction was discovered at the operation, but a portion of the appendix was perforated and sloughing.[21]

When the Appendix is strangulated the symptoms may be little more than local, as in a case described by Bayer. The appendix had entered a right femoral sac, and was strangulated at two centimetres from its free end. The symptoms, which endured for eighteen days, consisted of the local swelling and pain at the part which radiated over the right side of the belly and thigh.[22] In some cases, however, strangulation of the appendix produces constitutional symptoms of some gravity. The vomiting is not stercoraceous, though in one case it was said to be "offensive." In Javanelli's case there was constipation, with some degree of prostration, but no sickness.[23]

When the appendix has been strangulated without perforation it is usually much congested, and may be dilated into a cyst.[24] It is now the practice to remove the appendix when subject to inflammation. It was returned to the abdomen in Javanelli's case above referred to, and recovery was delayed by copious suppuration.

Obstructed Hernia.—A large hernia which has hitherto been reducible or irreducible, becomes obstructed, that is to say, the passage of the intestinal contents through it is interrupted, but it is supposed that

there is no interruption to the circulation in the wall of the bowel. As Professor Chiene observed, there is a local constipation.[25] In this condition, which has already been described on page 304, the rupture enlarges, becomes somewhat tense, but the impulse on cough can for a time still be obtained, especially near the neck of the sac. The bowels are constipated, and when sickness occurs, it comes late. Taxis and purgative enemata often suffice to cause the bowels to act and to restore the hernia to its normal state; but if these remedies fail, and the bowel is neither reduced nor emptied, the symptoms increase in severity and become identical with those of strangulation. The hernia becomes painful and tender, the belly is gradually distended, and sickness comes on, or, if already present, is aggravated. If the bowel is not liberated, the patient dies. These cases, as they occur generally in elderly persons and in large herniæ, are not favourable for operation, especially if this is long delayed; and as taxis, if well directed, usually succeeds with large herniæ at all periods of life, we may run the hazard of a somewhat lengthened attempt at reduction. If taxis or other means fail, the operation is as imperative in these cases as in any other.

Inflamed Hernia.—Inflammation of the parts contained in a hernia is commonly of low degree, and terminates in adhesion of one kind or another, without giving rise to symptoms of any consequence. If the process reaches a higher grade, it may extend beyond the sac to the general peritoneum, and cause symptoms so closely resembling those of strangulation that the two cases can hardly be distinguished.* The only sign which shows the difference with any certainty is the impulse on cough, but this may still be present when a loop is strangulated by a band, or in a pocket of the sac at the back of a large rupture. Much stress has been laid upon the fact that inflammation commences in the body of the sac, and extends thence to the neighbouring parts of the abdomen, whilst in strangulation the pain and tenderness begin at the neck of the sac. This difference is of little practical value.

Omental ruptures are occasionally subject to spontaneous inflammation, which may go on to suppuration. Cases have been recorded by Pott and others of omental ruptures that became inflamed in consequence of injury or of undue compression by a truss. The omentum suffered inflammation, suppuration, and even gangrene. The grave symptoms which sometimes ensued in these cases probably depended upon the extension of the inflammatory process to the peritoneal cavity. The damage caused by the pressure of a truss is usually limited to the rupture, and does not as a rule affect the abdomen.

* There are some rare instances in which a foreign body, that has been swallowed, lodges in a loop of intestine in a hernia, and may set up ulceration and perforation. The sac then inflames and suppurates.[26]

A man with a large omental hernia, which had been subjected to too much pressure, came under my care with acute inflammation of the skin of the scrotum, œdema of the subcutaneous tissues, and much tension of the sac, due to an effusion of fluid. There was some degree of fever, but the inflammation remained local, and ended in resolution with the use of mild remedies. Under these circumstances the symptoms are those of inflammation, and not of strangulation.

Malgaigne's Doctrine of Inflamed Hernia.—It will not be necessary to consider at any length that strange doctrine enunciated by Malgaigne,[27] and supported by Broca[28] and others, which asserts that many, if not the majority of herniæ, formerly deemed strangulated, are herniæ merely inflamed. Malgaigne observed with deep concern the terrible mortality after herniotomy in the Paris hospitals,* and actuated apparently by a humane desire to lessen this sacrifice of life, he conceived the idea that many herniæ are inflamed and not strangulated, and therefore may be treated without operation. His followers carried this teaching much further than Malgaigne himself.

A good instance of the kind of case which, according to this doctrine, may be treated expectantly, is given by M. Broca. A large scrotal hernia, easily reducible, at different times became irreducible when "certain accidents" supervened, which always ended in twenty-four or thirty-six hours under leeches and emollients. This happened for the third time, when M. Broca was called at the end of forty-eight hours, and found the patient in a grave condition, with obstinate constipation and "fæcaloid" vomiting. The tumour was tympanitic, and only slightly painful. Reduction seemed at first impossible, and the state of the patient precluded chloroform. M. Broca waited because formerly the "inflammation" had usually subsided, and the hernia had become reducible. On the third day the man was worse, and the operation was performed without opening the sac. All the "accidents" ceased, and ten hours later the rupture went back spontaneously, but the man died thirty-six hours after operation. M. Broca says, he operated not to relieve the strangulation, "which did not exist," but to facilitate the circulation in the organs in the scrotum.[29]

This doctrine, which M. Gosselin called the last shelter of the temporisers, has never affected to any important extent the practice of this country, but it appears to have done most serious mischief in France. If we take a practical view of the matter, it may be said that every case is strangulated in which the symptoms are relieved by reduction.

* Malgaigne says from 1836 to 1841, 183 herniotomies were performed by himself and colleagues in the Paris hospitals, and 62.2 per cent. died. Of those between fifty and eighty years of age 72.1 per cent. died.

Symptoms of Strangulation with a Hernia not Strangulated.

In many of the conditions above enumerated there have been symptoms of strangulation, more or less distinct, proceeding from a hernia. The cases may now be considered in which symptoms of strangulation arise in presence of a hernia which is not itself strangulated. The principal of these are enteritis, peritonitis, and internal strangulation.

Enteritis.—If an irreducible hernia is found in a person affected with enteritis, the symptoms may so accurately resemble those of strangulation, even to the stercoraceous vomiting, that some difficulty will be experienced. The local symptoms must be the chief guide, the indolence and lack of tension or tenderness in the tumour: yet these negative signs are not always reliable.

Peritonitis.—In peritonitis likewise the hernia can only be excluded by the absence from it of the signs of strangulation. Goyrand met with a woman, æt. 72, whose abdomen was distended and painful, and who had constipation, frequent vomiting, and prostration. At the umbilicus was an irreducible hernia, but it was soft and painless. After death she was found to have had peritonitis, produced by the rupture of an ovarian cyst.[30] But the uncertainty of the local signs is well exemplified by that case of Sir Astley Cooper's, of a woman suffering from general peritonitis. She had an umbilical hernia as well as one in each groin. All were irreducible, and the right hernia was very tender. She died without operation. The right swelling was an inflamed gland over an empty sac: the left contained bowel; and the umbilical hernia held omentum, each affected by peritonitis, which was general.[31]

Internal Strangulation. There are not a few instances in which an irreducible hernia has been found together with an internal strangulation, and has given rise to difficulty. Sir W. Stokes operated in vain, on account of symptoms of strangulation, upon a scrotal hernia which was irreducible, but free from tension and flaccid. The bowel was strangulated by a band within the abdomen at the junction of the jejunum and ileum.[32] It would be prudent in such cases to examine the hernia, even though the local signs were negative, before proceeding to laparotomy. A case of even greater difficulty has been recorded by Mr. Hulke. A woman, æt. 64, had long had a rupture in the right groin, which came down two days before admission, and could not be returned. She suffered much pain in the hernia and in the belly, she retched constantly and had no stool. Mr. Hulke opened the sac, which contained bloody serum (repeated taxis had been made by another surgeon) and a small piece of omentum, and nothing else. After divi-

sion of the stricture, the omentum, which was little altered, was returned. The symptoms persisted, and the patient died four days later. Within the pelvis a piece of the ileum was found strangulated under a band. Mr. Hulke supposed that the internal strangulation and that of the hernia were coincident. Solly met with a case very much resembling this in which two strangulations were contemporaneous. A portion of bowel was slightly strangulated in an inguinal sac. This was liberated, but death ensued from strangulation of another piece of small intestine by a band connected with the cæcum.[33]

Symptoms resembling those of Strangulation together with an Irreducible Hernia.—An ordinary **colic** might be mistaken for strangulation when it is accompanied by constipation and vomiting, and when the rupture is irreducible. The late Mr. Hancock was present at an operation for strangulated hernia in which no obstruction was found, though all the symptoms were present. The man lived for three weeks, during which it was discovered that he was suffering from lead poisoning.[34] The absence of local symptoms and the paroxysmal nature of the attack are the chief means of distinction in ordinary colic. So also the **vomiting of pregnancy** has aroused suspicion as to the state of an irreducible rupture, but little real difficulty can be experienced in such a case.

Symptoms resembling those of Strangulation together with a Swelling which is not a Hernia.—There are several swellings found in hernial regions, not being themselves herniæ, which give rise to symptoms resembling strangulation. An inflamed hernial sac, no longer occupied, is one of these. A woman, æt. 42, noticed, during three weeks, a swelling in the right labium which extended up to the inguinal canal. It was the size of a goose's egg, was only slightly tender, and was not reddened. At length the belly became painful, and nausea came on. A dose of castor oil and an enema failed to procure a stool. On the third day the swelling was larger and very painful, even on light pressure. Theilhaber opened the sac, and let out some muddy flocculent fluid. The sac wall was inflamed, and a sound could be passed upwards through its neck into the abdomen.* [35] A similar case was described by F. Obtulowicz,[36] and Bardeleben quotes one from Sanson in 1830.[37] In all these cases the symptoms subsided after operation.

Inflamed Glands in the bend of the thigh have also raised a suspicion of strangulation. A woman, æt. 35, came under the care of Sir W. Stokes two days after she had been kicked in the groin. A painful swelling had formed at the part, accompanied by continual vomiting and retching, by constipation and abdominal tenderness. A painful globular tumour occupied the site of a femoral hernia. The operation

* This was possibly an inflamed hydrocele of the canal of Nuck, a condition which has simulated strangulation. (C. Brunner, Beiträge z. Klin. Chir., 1889, vol. iv. p. 1.)

revealed a mass of inflamed glands, but no hernia. The glands were removed, and the symptoms subsided.[38]

Blood in the Ligamentum Teres.—The late Mr. Callender described the case of a woman, æt. 37, who felt something give way in the left groin, as she was lifting a pail, the day before admission. A considerable swelling formed at once, and local pain. She was presently sick. When she came under observation she still vomited, and the bowels were confined. An operation was performed, and the tumour was seen to consist of a clot of blood following the course of the ligamentum teres, and firmly bound down by the fascia. She made a good recovery.[39]

Inflamed Spermatic Cord.—It is needless to carry further the description of exceptional cases which are found in such variety in the records of surgery. I will conclude this part of the subject by referring to cases of inflammatory thickening of the spermatic cord. Two such cases were reported by Mr. Quain, in one of which vomiting, constipation, and abdominal pain lasted for three days. An enlargement was found in the right half of the scrotum, which was said to have appeared suddenly. The incision disclosed a small hydrocele of the testis, and above it a thickening of the vas deferens and of the adjacent tissues. No trace of gonorrhœa was detected.[40]

In the foregoing pages it has been seen that local symptoms are often not distinctive, and at times may be altogether misleading. Inasmuch as strangulation may occasion inflammation of the parts in the sac, and the same parts may be inflamed independently of strangulation, and as some local signs, such as tension and tenderness, may be absent in a strangulated and present in an irreducible rupture, local signs cannot be relied upon to distinguish the strangulated from other herniæ. It will have been observed that the eminent surgeons whose cases have been above referred to, always proceeded to operation when uncertainty was felt as to the nature of the malady, herein following that golden rule which runs, "When in doubt, operate."

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CHAPTER XXXVIII.

ON THE TREATMENT OF STRANGULATED HERNIA.

The Means of Reduction—Taxis and Herniotomy.—When a surgeon is convinced that the hernia before him is strangulated, he must at once proceed to return the protruded parts. The means of reduction are the taxis and the operation of herniotomy.

Adjuvant Remedies.—Many writers of distinction have advocated the employment of other remedies before using these, and have brought forward numerous successful instances; but all their various methods are subject to a serious objection, from which the taxis is not altogether free. They need time for exhibition; and if they fail, as they often will, the loss of time may be of vital consequence. Moreover, no agent, other than the operation, can be employed with safety, unless we have previous assurance of the integrity of the parts in the sac, and this assurance it is hardly possible to obtain.

Of all the adjuvant remedies the warm bath is the one which, if not the most ancient, has survived the longest. It is still ordered, as a routine practice, in certain hospitals. Its mode of action is supposed to be that it relaxes parts which are in a state of tension. Perhaps some trace of the old theory of spasmodic strangulation lingers still in the minds of those practitioners who administer a hot bath. If we can satisfy ourselves that a delay of an hour's duration is justifiable, we may use it, and are fortified by the fact that many herniæ return during or after the bath, when taxis has already failed. It happens not unfrequently with irreducible ruptures that, if taxis is suspended for a time, it succeeds on a second attempt. The changes that take place in a rupture during the interval, which render it reducible, are not known, nor has the action of the bath, by which also the patient obtains a period of quiet, been ascertained with certainty. If its advantage lies in the relaxation induced by it, there is no relaxation so complete as that from chloroform, whilst the use of the drug involves no loss of time. If reduction by taxis is possible, it is never so likely to succeed as when the patient is under an anæsthetic, and the surgeon is not impeded by the struggles which pressure upon a tender rupture excites. Taxis often fails because sufficient attention has not been given to the mode of performing it. When it is conducted in a skilful manner and is unsuccessful, there is very little probability that either a bath or chloroform will lessen the difficulty. But whatever can be done by the bath will be done far better by chloroform, and without loss of time. The value of the bath therefore appears at least doubtful, and though it must not be classed with those dangerous remedies of former times, such as bleeding, cold, and the tobacco enema, it is not far removed from that form of treatment which has been termed by Pott a "specious trifling."*

The Mode of making Taxis has already been described at some length in Chapter XXIII., where the reduction of non-strangulated hernia was considered. In a strangulated hernia the sac is usually tense, and often has a layer of fluid over the viscera at the anterior and lower

* Mr. Bryant has recommended proceeding to taxis or operation without wasting time over the bath.[1]

part. Under these circumstances the contents cannot be felt, and cannot be manipulated. Lateral or to and fro movements of the sac, which Lossen has recommended, with a view to emptying the loop through its lower end, I have not found of especial value. Drawing down the sac is followed sometimes by reduction of the fluid in it, which is usually the first step to reduction of the bowel. Drawing down the intestine itself can rarely be accomplished, but, when possible, is of much efficacy, as the fluid within the loop may then escape into the bowel within the abdomen. A pull from the abdominal side by pressure above the sac, according to my experience, seldom gives much aid.

The Causes of Irreducibility are found partly in the effusion in the sac, partly in the effusion into the bowel by which it is distended, and partly in the thickening of the walls of the loop from congestion and inflammation. The effect of adhesions in opposing reduction appears to be quite subordinate in strangulated hernia.

Aspiration of the Sac and of the Bowel.—The presence of fluid in the sac has been considered as an obstacle to reduction because, firstly, it prevents the application of pressure directly to the solid contents; secondly, when reduction is about to take place, the fluid in the sac is the first to leave it; and thirdly, after its withdrawal by means of a syringe, it has often been possible to return the viscera. Ravoth maintained that large herniæ owe their size in great measure to this effusion of fluid into the sac, and he recommended and practised its removal by means of a trocar.[2] Professor Kocher agrees to limit this procedure to somewhat large herniæ, but differs from the majority of surgeons in regarding the presence of fluid in small herniæ as advantageous, by causing an equal distribution of the pressure over the bowel when taxis is used.[3]

A proceeding similar to this, for assisting reduction by taxis, is that of Dieulafoy,[4] who aspirated the protruded gut itself, and drew off the fluid and gaseous contents. Giraldés proposed first puncturing the sac and afterwards the intestine.[5] Dieulafoy mentions 27 cases subjected to aspiration, of which 20 were reduced without difficulty, when taxis under chloroform had failed. Mr. John Hern recorded, in 1891, 33 cases which had been treated in this way by means of a fine hypodermic syringe, and in 29 reduction was effected.[6] Mr. Hern restricts the use of this method to cases which are recent, and to those who refuse operation. Professor Hueter points out that puncture of the intestine, even by a fine needle, will permit the escape of septic matter into the sac, whence the general peritoneum may be infected.[7] As a rule, however, the puncture does no harm.[8] It is not the danger which may come from the puncture that limits the application of these two methods. Aspiration

is subservient to taxis, and can only be employed when attempts at reduction are justifiable.

The Use of Taxis in Strangulated Hernia.—The question here arises whether taxis should be used on a strangulated hernia. There are certain cases in which it is obvious and beyond dispute that taxis must not be used, as when the integuments are gangrenous or inflamed or contused; also when well-marked signs of depression are observed, whatever the duration of strangulation; and when the symptoms have lasted some days, even if the patient's condition is favourable. Some might approve of making a fresh attempt at reduction when a previous attempt by another surgeon has not succeeded, but this appears to be a very dangerous practice. I have twice found the bowel in the sac burst after taxis at which I was not present, though no outward sign gave notice of the injury. There are no means of judging of the amount and direction of the force that has been used beforehand, but we know that it has failed, and is therefore likely to have been considerable. So that even with other circumstances propitious, the wisdom of repeating the taxis is at least open to question.[9]

There is no fixed rule for the employment of taxis in cases which do not fall under the above-named categories, and this appears to be due to the fact that neither the duration of the symptoms nor the degree of their severity indicates with certainty the extent of the damage that the included bowel has sustained. It was noticed in a previous chapter that mild constitutional symptoms may accompany well-marked lesions and acute symptoms slight lesions, and that in some cases a short strangulation will produce gangrene, whilst in others the bowel will be almost sound after constriction for several days. But there is no doubt that in general the duration of the symptoms fairly corresponds with the extent of the local lesions. The relation between the latter and the intensity of the symptoms is less certain. There is not much danger of error, if the symptoms are mild, and have lasted only a few hours. But beyond this, if we proceed to taxis, we hazard a guess as to the soundness of the hernial contents. After strangulation has lasted more than a few hours, one surgeon will differ from another in his use of the taxis, partly according to his disposition to take things for granted, and partly according to his estimation of the dangers of herniotomy.

Taxis in Large Herniæ and in Children.—There are two cases in which taxis may be employed with less reserve. In the large herniæ of adults, even though strangulation has lasted some days, taxis is not unsafe if the symptoms are not acute. For these ruptures are generally reducible, and the operation upon them is very perilous. Again, when strangulation happens in children, reduction of the hernia takes place with so few exceptions, that taxis may be given a full trial, and may be

repeated more than once.* If the symptoms are urgent, but not of long duration, taxis may still be used in children.

The Force and Duration of Taxis.—The force that may be applied to a strangulated hernia should never be considerable, for the tunics of the gut undergo changes very early which impair their strength, and as the bowel is so placed that it cannot yield to any great extent, it is apt to burst under powerful pressure. In most of the recorded and unrecorded cases in which serious injury has been done to the hernial contents, the taxis has been continued for a length of time. Attempts at reduction persisted in for an hour or more on this ground cannot be too severely reprehended. If the surgeon is at all skilful, and gives close attention to the mode of applying the pressure, five minutes at most will suffice to determine whether the hernia is reducible.

The Whole Protrusion must be Reduced.—When taxis is successful, the parts go completely back, and the surgeon should not be satisfied if anything is left in the sac. A hernia long irreducible may, by the addition of a loop of gut, become strangulated, and taxis may effect the reduction of this without altering the main body of the swelling. If the surgeon, from previous acquaintance with the case, knows that it was formerly irreducible, he may venture to wait to see if the symptoms subside. Otherwise he would be unwise to trust the patient's declaration alone as to the former condition of the rupture. Not unfrequently a part only of the intestine in a rupture is reduced by taxis, and a surgeon has been known to return the contents of a loop instead of the loop itself.[12] As a rule, if anything is left in the sac, the operation must be proceeded with. It is less dangerous to perform early a needless operation than a needful operation late.

The Dangers of Taxis.—The dangers of taxis are principally three. The greatest is, probably, that one, above mentioned, of laceration of the gut; secondly, the return of the still strangulated hernia with its sac, "réduction en masse;" thirdly, as the fluid in the sac has sometimes a putrid odour, and contains septic matters, Verneuil supposed that if this fluid entered the abdominal cavity, it would set up a general peritonitis. It is difficult, if not impossible, to estimate the amount of damage due to the strangulation and to the taxis in cases which come to operation. Many surgeons consider the previous taxis one of the principal dangers

* The rarity of strangulated hernia in children, and the facility of reduction when it does occur, were noticed by Blegny.[10] Mr. Holmes observed in 1867 that there had been no herniotomy at the Children's Hospital in thirteen years, and Mr. Marsh in 1874 recorded the first operation for strangulation at that hospital in twenty-three years.[11] The facts noted by Blegny have been, of course, well known to the surgeons of the Children's Hospital, whose practice has established their accuracy. But, if one may judge from the number of operations performed on children of late years, these facts are not generally known or are lightly regarded.

attending the operation. Boyer published some statistics, too meagre unfortunately to be of much value, which bear upon this subject.[13] From 1834 to 1839 Boyer made long attempts at reduction before operation, and lost eight patients and saved one. From 1839 to 1843 he much limited his use of taxis, and had seven operations with four deaths. From 1843 to 1846 he almost abandoned taxis, and operated fourteen times, with ten recoveries and four deaths. Manec, during the same period, always operated without taxis, and in twenty-eight operations had only two deaths (= 7.1 per cent.). This is one of those lamentable indications that a surgeon who uses taxis with the most humane intentions, is increasing the danger which he is endeavouring to quell.

Even when reduction of a strangulated hernia can be effected by taxis, recovery is by no means invariable, for, as Mr. Bryant has shown, in inguinal cases 3.8 per cent., and in femoral cases 10.5 per cent., die after successful taxis.* [14] The bowel sometimes is so injured that after reduction it mortifies, and its contents are poured into the peritoneal cavity. Streubel collected forty examples of this accident alone.[16] Probably the safest rule for the employment of taxis would be to use it solely in the early hours of strangulation, and only then if the local and constitutional state is favourable; to make the attempt with all gentleness, and to continue it only for a few minutes.†

The Mortality according to the Duration of Strangulation.—The reluctance of some medical men, even at the present day, to operate, does not depend altogether on constitutional disposition, but is justified in some measure by the large mortality which still attends herniotomy at the hospitals. But it is evident that Hospital Statistics do not present the case fairly for the operation. They are derived from cases that have passed through several hands, and have necessarily suffered delay. It is probable that the statistics of a surgeon who is prepared to operate without transferring the patient, would show more correctly the actual danger of herniotomy. But unfortunately such figures are seldom to be found, and I can only now point to twenty-one operations from the private practice of C. Koch of Nurnberg, with 9.5 per cent. of deaths.[18] This is far below the death-rate in the hospitals, but it cannot be justly compared with theirs on account of the small number of cases from which it is taken. The Hospital Statistics, however, have been of service over and over again in showing that the longer the duration of strangulation, the greater the mortality. So long ago as 1838, W. King remarked that the operation was admitted to be safe in proportion to the shortness of the

* Frickhoffer quotes 308 femoral cases treated by taxis and therapeutic means with a mortality of 14.9 per cent., and 518 inguinal with a mortality of 7.8 per cent.[15]

† This amounts very nearly to the conclusion at which Mr. Holmes arrived in 1867, from an analysis of cases at St. George's Hospital.[17]

interval before its performance.[19] The statistics of Frickhöffer and others show this in the clearest manner. Frickhöffer collected the cases of herniotomy that had occurred in the Duchy of Nassau between 1822 and 1858, which amounted to 382, and in drawing attention to the results, he observes that the operations were done by no means always by a practised surgeon's hand.[20] Of those strangulated

For 1 day or less	19.4 per cent. died.
For 2 days	49 „ „
For 3 „	40.9 „ „
For 4 and 5 days	50 „ „

In Luke's cases, after strangulation

For 48 hours or less	17.6 per cent. died.
And after more than 48 hours	40 „ „

Mr. Warrington Haward[21] also has shown that with strangulation of inguinal hernia lasting

1 day or less	16.6 per cent. die.
2 days	40 „ „
3 „	62.5 „ „

and with strangulation of femoral hernia lasting

1 day or less	10 per cent. die.
2 days	25 „ „
3 „	26.3 „ „
4 and 5 days	33.3 „ „

Mr. Holmes' figures show that in inguinal and femoral herniæ strangulated

For less than 24 hours	17.7 per cent. die.[22]
And for 1 day and less than 2	27.9 „ „

Since the appearance of the above-quoted publications aseptic surgery has come into vogue, and the mortality in recent statistics is somewhat less than of old, but the same relative difference is noticed in the death-rate according to the duration of strangulation. Reichel has furnished tables of cases from 1876 to 1885,[23] and Habs has reported those under Professor Hagedorn from 1883 to 1890, all treated aseptically. By combining the inguinal and femoral cases of these two authors a total of 129 is obtained, which were distributed over the first five days of strangulation.* The result is that

* Dr. R. Habs has published 170 cases of herniotomy for strangulation, which include 26 of strangulated omentum. This is such a large proportion of pure omental herniæ that it awakens some misgiving, and I have excluded these cases from the computation in the text.

12.5 per cent. died after 1 day's strangulation or less.
26.1 „ „ 2 days.
30.3 „ „ 3 „
44 „ „ 4 and 5 days.

In all the lists above given the mortality is more than twice as great in the second day of strangulation as in the first.* The facts concerning the danger of delay have been long recognised by hospital surgeons, but that they have not yet reached all branches of the profession is evident from the heavy mortality still attending the operation. The patient who dies after twenty-four hours of strangulation, in most cases owes his fate to the negligence of his surgeon, and the latter, when he ventures to postpone the operation, is accepting a grievous responsibility.

Mortality of the Operation according to the Age of the Patient.—The age of the patient likewise has a manifest effect upon the result of the operation. This may be seen in the following summary drawn up from Table XXXII., which comprises 1063 cases of inguinal and femoral hernia.

Hospital Cases Operated upon for Strangulation.

Age.	Death-rate, per cent.
Under 5	25.8
5 10	...
10 20	20.8
20–30	17.0
30–40	20.8
40–50	30.3
50–60	42.5
60–70	48.4
70+	62.0

Under five years of age the cases are almost altogether male inguinal, and the high death-rate during this period,† as well as from ten to twenty years, is no doubt due to the herniæ being frequently in the tunica vaginalis, for in such cases strangulation is usually severe. After twenty years of age there is a steady increase in the mortality, till towards the end of life the chances of recovery are nearly one against two.

The cases in Table XXXII. have been arranged in two periods of ten years each, the first from 1869 to 1878, and the second from 1879 to

* The improvement in the death-rate after herniotomy, since the introduction of aseptic surgery, has not answered expectation. According to Benno Schmidt, this is due to the fact that the field of operation is already septic before herniotomy begins.[24]

† Benno Schmidt collected 64 cases of herniotomy in children with a mortality of 32.8 per cent. More than half the cases were in the first year, about a quarter in the second year, and the remaining quarter between the third and thirteenth years. (Unterleibsbrüche, 1882, p. 175).

TABLE XXXII.—*Cases of Herniotomy from Four of the London Hospitals between the Years* 1869 *and* 1888, *arranged in Decades. The Patients are entered according to their Ages at the time of Operation.*

	Total.		Under 5		5–10		10–20		20–30		30–40		40–50		50–60		60–70		70 +	
	R.	D.	R.	D.	R.	D.	R.	D.	R.	D.	R.	D.	R.	D.	R.	D.	R.	D.	R.	D.
Inguinal Hernia.																				
1869 1878. Males .	84	57	3	1	...	...	5	3	18	8	14	6	23	11	10	14	8	8	3	6
1879–1888. Males . .	166	92	19	7	1	...	12	2	45	7	24	10	32	20	16	20	11	15	6	11
	250	149	22	8	1	...	17	5	63	15	38	16	55	31	26	34	19	23	9	17
1869–1878. Females .	14	16	...	...	...	...	...	...	1	...	4	1	5	1	4	6	...	5	...	3
1879–1888. Females .	19	3	1	...	...	...	...	...	3	...	3	...	2	1	5	2	3	...	2	...
	33	19	1	...	...	...	...	...	4	...	7	1	7	2	9	8	3	5	2	3
Femoral Hernia.																				
1869–1878. Males . .	18	11	...	...	...	...	1	...	2	...	...	2	5	3	4	3	4	2	2	1
1879-1888. Males . .	28	28	...	...	...	...	1	...	1	...	4	...	7	5	4	6	9	11	2	6
	46	39	...	...	...	...	2	...	3	...	4	2	12	8	8	9	13	13	4	7
1869-1878. Females .	117	80	...	...	...	...	...	...	3	2	22	4	30	10	29	22	22	29	11	13
1879-1888. Females .	225	105	...	...	1	...	...	...	10	...	35	5	61	21	55	21	45	26	18	32
	342	185	...	...	1	...	...	...	13	2	57	9	91	31	84	43	67	55	29	45
Total, 1063.	671	392	23	8	2	...	19	5	83	17	106	28	165	72	127	94	102	96	44	72

Note.—The Table is made up of cases from the Statistical Reports of St. Bartholomew's Hospital for the twenty years 1869–1888. To those in the first decade are added cases from the Reports of St. George's Hospital from 1870 to 1879, and to those in the second decade are added the cases from the Reports of University College and St. Thomas's Hospital (excepting the year 1880 of St. Thomas's). I have as far as possible eliminated cases of strangulated omental hernia. R=Recovered ; D=Died.

1888. This has been done with the intention of showing the improvement in the death-rate after the introduction of aseptic surgery, which was not in universal use before 1879, and even after that date some surgeons adopted it either not at all or in a faint-hearted way, so that all the cases in the last decade were not treated aseptically. The difference in the total death-rate is only 7 per cent.,* and it is probable that this improvement is not all to be ascribed to the effect of asepsis. Benno Schmidt has also noted the very slight amelioration due apparently to the new plan of treatment, but in opposition to his statement Gussenbauer has quoted 160 cases, collected by one of his assistants, treated aseptically without a death. There must be two factors here concerned, and the improvement may be owing to the earlier performance of the operation. The statistics of Habs already referred to (1883–1890) comprise 162 operations, inguinal and femoral, with a mortality of 15 per cent.[25] He has included among the number twenty-six strangulated omental herniæ, and when these are excluded, the death-rate is 18.4 per cent.† All these cases of Hagedorn's were treated aseptically, but at the same time taxis was used sparingly, and the operation was done without delay.

It may seem superfluous at the present day to dwell so long upon the importance of performing the operation early, but no one will deem it superfluous who is acquainted with the Hospital Reports, and knows what a large proportion of cases come to operation on the second and third days, or later.‡

The operation was regarded for long after its introduction as a last resource, and the inventor, Pierre Franco himself, speaks of using it at the end of three days of strangulation if the patient can wait so long.[27] Ambrose Paré appears to have followed the same practice. Almost alone among the earlier writers, Antoine Le Quin expressly warns the surgeon not to wait for extremities.[28] The natural reluctance of the patient to undergo a painful and somewhat lengthy operation, in which,

* From 1860 to 1878, there were 307 cases, with a mortality of 41.3 per cent.; and from 1879 to 1888, 666 cases, with a mortality of 34.2 per cent.

† Reichel records ninety inguinal and femoral herniæ treated by operation from 1876 to 1885, with a death-rate of 30 per cent. Krumm also from 1877 to 1889 did sixty-one herniotomies with 22.9 per cent. of deaths.[26]

‡ Among the cases in Table XXXII., from 1877 onwards, the duration of strangulation was noted in 121. The operation was done after

24 hours and less than 48	. . .	in 20 cases.
2 days	. . . . .	„ 27 „
3 „	. . . . .	„ 29 „
4 „	. . . . .	„ 20 „
5 „	. . . . .	„ 10 „
6 „	. . . . .	„ 5 „
7 „	. . . . .	„ 7 „
8 „	. . . . .	„ 3 „

if he took Franco's advice, he also lost his testicle, contributed to delay its performance, and thus the teaching of Franco, concurring with the wishes of the patient, obtained for the operation a death-rate far above its due. Even so late as 1710 Dionis speaks of it in most desponding terms as generally fatal.[29]

Soon afterwards the celebrated surgeons of France adopted and taught a less timorous practice, and in all the considerable works on the subject at the latter end of the last century the dangers of delay are constantly insisted upon. Yet notwithstanding this the surgeon was advised to use a number of minor remedies, some of which were dangerous, all of which consumed time, before undertaking herniotomy. During the first half of this century the same routine treatment prevailed, and was supported by the authority of Sir Astley Cooper and Sir William Lawrence.*

There was one surgeon, however, Mr. John Taunton, contemporary with these, who followed a different practice, and had many opportunities of testing its value among the patients of the City of London Truss Society, which he founded in 1807. His mode of proceeding was described by Macilwain in 1845 in the following terms:[30]—

"When a case was presented to him, he seems first to have attempted the reduction of the hernia by the taxis, in which he is said to have been particularly adroit, and, failing in this, he immediately proceeded to the operation. He then left his patient to repose. He neither bled before nor after the operation. . . . There is no record of cases except those which were necessarily entered in conformity with the rules of the Truss Society as regards those who are relieved by it. At his death this record reported fifty-one operations, all of which, with one exception, had been completely successful."

Mr. Kingdon has told me that Mr. Taunton performed many of these operations on the weavers who then formed a large colony in Spitalfields. They are a short, lean race of people, particularly subject to femoral ruptures.

Macilwain, who furnished the above record, followed the same practice as Mr. Taunton, but little notice appears to have been taken of the testimony of these two surgeons by the profession at large. It has now been the rule at some of the London hospitals for many years to operate without appreciable delay in strangulation, and therefore the mor-

* Sir Astley Cooper says regarding the time for operating, "as soon as bleeding, the warm bath, the tobacco clyster, and topical cold have been fairly tried and have proved unsuccessful," the operation may be performed (On Abd. Her., 1827, p. 35). Lawrence says, "I wish to impress the surgeon with the propriety of giving, without delay, an adequate trial to means of real efficacy" (*i.e.*, taxis, the warm bath, bleeding, tobacco clyster, cold), "and of performing the operation as soon as it can be clearly perceived that these are unsuccessful" (On Ruptures, 5th ed., 1838, p. 174).

tality, which is still so considerable, must not be imputed to the operator. In some cases the patient himself is answerable for the delay, but in the majority it is to be feared that the practitioner, first called to the case, has lacked promptitude. In no province of surgery is the old adage more true than in this, that "delay breeds danger."

Details of the Operation for Inguinal Hernia.—The operation for the relief of strangulated inguinal hernia when the bowel is in a condition fit to be returned, will now be considered, and the description will necessarily comprise the rules which apply to herniotomy in general. Afterwards the peculiarities of the operation for femoral and other herniæ will be studied, as well as the difficulties and dangers which beset all these operations. As the object of the operation is to return the protruded gut, the steps consist (1) in exposing and opening the sac, (2) in dividing the stricture, and (3) in returning the strangled parts. It will not be necessary to go into the merits of the operation without opening the sac. The objections to opening the sac have disappeared with the introduction of aseptic surgery, and the danger of doing so is now immaterial, whilst the danger of not doing so is as real as ever. But the sac should not be opened, if possible, in very large herniæ, and it is in these that this operation is now chiefly valuable.* Neither will it be necessary to say anything of the aseptic precautions to be observed, which are now well known to every student of surgery.

The instruments needed are a scalpel and a hernia bistoury, of which there is none better than that of Sir Astley Cooper, "which is blunt not only at the end, but for the next three-eighths of an inch; it then has a cutting edge of about three-quarters of an inch, and is blunt along the remainder of its concavity." Pressure forceps, artery and dissecting forceps; a director with a deep groove, retractors, a needle in handle, sterilised fine silk, needles, sponges, dressings and solutions, and a many-tailed bandage; clamps for the bowel (4) or small elastic tubing.

In all operations, but especially in this one, it is requisite that the patient should be exposed to cold as little as possible, and therefore the trunk and lower extremities should be well protected beforehand by blankets, but not so as to obscure the field of operation The bladder must be emptied and the surface shaved. When the patient is suffering from prostration and abundant fæcal vomiting, it has been proposed that the stomach should be emptied and washed out. This appears to have been suggested by Sonnenburg,[31] and has been practised and strongly recommended by Mr. Treves.[32] It has lately been advocated by Mr. Hulke and others.[33] It is immaterial, according to Mr. Treves, whether the washing out is done before or after the operation, so long

* Both Pierre Franco and Paré, after dividing the tissues about the neck of the sac, used to try reduction before proceeding to expose the gut.

as the patient is still under the anæsthetic. It might be supposed that a patient in a state of prostration would not be benefited by any measure which prolonged the operation or added to the shock, but Mr. Treves has observed that the "shock has been distinctly modified by flushing the stomach with warm or hot water." In certain cases when a patient is under chloroform, the fluid contents of the stomach keep pouring from the mouth, and it is in such as these that washing out the stomach may be advantageous. Mr. Treves finds the syphon irrigator the best, and uses water at a temperature of 100°.

The First Incision which divides the skin and subcutaneous tissues should be in line with the long axis of the tumour, and should begin a little above its highest point. This precaution, whereby the external oblique aponeurosis is exposed, is needful, as it makes clear the anatomical position of the neck of the sac, and informs the surgeon as to his true depth in the early part of the operation. The first incision may be made either with a free hand or by raising up a transverse fold of skin across the upper part of the swelling, the assistant holding one end of the fold and the operator the other, which can be instantly divided by introducing the knife through the fold with its back to the hernia and cutting towards the surface. This incision was recommended by Scultetus,[34] and was frequently used before the days of chloroform on account of its rapidity. It has also the advantage of dividing no more than the skin, subcutaneous tissue, and dartos. It is still of service when the surgeon is not quite sure of his hand, or when his nerves are not quite steady. The incision should be carried downwards to the end of the hernia, if that is of small or moderate size, but in large herniæ it is not desirable to make an incision of such great extent. Any bleeding vessels should be caught in pressure forceps in order to keep the field of operation clear. In a bubonocele the aponeurosis of the external oblique is next divided, but in a scrotal hernia it may not be necessary to do this. A part of the spermatic cord sometimes runs down the front of the tumour, and therefore the first cut in a scrotal hernia does not go deeper than the subcutaneous tissue.

The incision must be continued in the same line through the deeper layers, care being taken to avoid the vas deferens, if present, till the sac is reached. The different coverings described by the anatomist are seldom recognised, but the cremasteric fascia is often conspicuous. There is no constant relation between the age or size of the rupture and the thickness of its coverings, and therefore it is well to divide the layers, which are sometimes very numerous, carefully. All these incisions should be carried from end to end of the superficial one.

Opening of the Sac.—As the sac is approached, its surface has often, though not invariably, a greyish blue colour, like that of a denuded

varicose vein. The knife should be held with the blade horizontal, and the tissues be picked up in small portions with the dissecting forceps, and cut parallel to, not towards, the surface of the sac. There is little difficulty in arriving at the sac when it contains fluid and is not very small, for the sense of fluctuation assures us of its presence, and we have only to cut steadily on till we see it escape. If the sac is very tense, it is fluid that makes it so, and there is no dilemma in these cases.* If the sac is not tense, whether it contain fluid or not, we can take up a piece between the finger and thumb and can feel it slide on the surface of the hernial contents. A small piece can then be taken up in forceps and cut with the knife on the flat. If no fluid is present, a director can yet be passed into the opening and be moved freely round the cavity. Furthermore, if the opening is enlarged, the congested bowel is seen within, when there can be no longer any doubt.

The gliding of the sac over the parts contained and the detection of fluid are the two principal means by which we discover the vicinity of the sac. In rare cases the bowel is applied to the inner surface of the sac, and united with it by soft adhesions. By cutting carefully small openings at a time the cavity is reached, and the coloured bowel is seen through the minute aperture. Lawrence observes that "if the division of the exterior investment should lead the surgeon to suppose that he has cut into the true hernial sac, he will be undeceived on finding that the director will not enter the cavity." Mr. Jacobson and Mr. Treves direct that any doubtful layer should be drawn gently down, and its continuity with the structures of the abdomen and thigh traced above and below, as can be done with the previous layers, for thus it is seen that the sac is not yet reached. Rigaud recommended, when in doubt whether it is the bowel that has been exposed, or only the sac, to shave off a little piece from the surface. If it is bowel, the bleeding is altogether out of proportion to the size of the wound.[35]

The Division of the Stricture.—When the sac is opened, there is no difficulty in recognising the omentum or intestine if the incision is free. These contents should be gently examined before proceeding to the next step—the division of the stricture. The cause of irreducibility, in rare instances, is in the coverings of the sac; and when this happens, the incision which exposed the bowel at the same time liberated the stricture. More commonly, though still rarely, the stricture is at the external ring, especially in children; and this can easily be divided if it has been brought well into view, either on a director or with a free hand. If, as is most usually the case, the stricture is at the neck of the sac, or inner ring, more circumspection is needed.

* The fluid in the sac is sometimes under considerable pressure, as is manifest from the force with which it escapes. Dionis says, he had seen it fly up to the bed's tester.

The incision in the sac should admit of the left index finger being passed up to the seat of stricture, which must be defined by the finger-tip or nail. The hernia bistoury, which has a blunt extremity, is then carried along the finger flatwise till the stricture is reached. The finger must keep the bowel or omentum away from the knife whilst it is pushed carefully, in the same position, through the stricture; and when it has gone so far that its cutting edge has just reached the abdominal side of the orifice, the knife is turned, and the resisting ring divided to the extent of quarter to half an inch directly upwards. This act is facilitated, if the edges of the sac near its upper part are drawn down with artery forceps by the assistant. If the hernia is in a portion of the processus vaginalis, the stricture is apt to be very tight, and much patience and dexterity may be needed to insinuate the knife into the opening, and to make the incision without wounding the viscera. It is not always known at an operation whether the hernia is oblique or direct, and therefore, to avoid the risk of wounding the epigastric artery, the rule of cutting upwards, parallel with the middle line, was laid down and conclusively established by Petit, Astley Cooper, Scarpa, and Lawrence.

Wound of the Epigastric Artery.—The incision should not be larger than is just necessary to free the parts, for though the epigastric artery is very seldom injured, it has not always escaped. Several instances are on record of division of this vessel when the direction of the cut has been oblique instead of directly upwards.* But even when the incision has been correctly made, it appears to be possible to reach this artery, for it was accidentally divided in 1887 at St. Thomas's Hospital in a man who was undergoing inguinal herniotomy. Very free bleeding occurred at once, whereupon the wound was enlarged upwards, and both ends of the vessel were ligatured. The epigastric generally skirts the inner side of the internal abdominal ring, so as to be quite out of the way of the surgeon's knife in the vast majority of cases, when this is directed upwards. A curious deviation from its usual course was noticed by Velpeau, who found the artery, as it passed the neck of the sac, tending so much outwards that it formed a sort of half circle, whose upper extremity might have been endangered in the operation.[37] †

Examination of the Strictured Parts.—After the stricture has been relieved, the finger or director should be used to enlarge the opening.

* In some of these cases, which appear to be genuine, this large vessel has been severed, and yet there has been no subsequent hæmorrhage. Lawrence refers to such cases, and one is recorded by Paul in which the surgeon, when dealing with a direct hernia, cut obliquely outwards and nearly half divided the epigastric. The woman died, but there was no bleeding.[36]

† Lawrence cites two instances of wound of the cremasteric branch of the epigastric artery, followed by free bleeding.

The next step is a very important one, and consists in drawing down and examining the parts that have suffered constriction.* So many have perished from the surgeon's disregard of this rule, that it can never be neglected with safety. Within the last few years, a young man, whose hernia had been strangulated only five hours, was operated upon at St. Thomas's Hospital. After division of the stricture, reduction was attempted without inspection of the line of constriction. Fæcal matters were seen coming from the neck of the sac, and when the bowel was drawn out, an opening in it was found involving one-half of the circumference. Even so great an operator as Sir William Fergusson lost a life in exactly the same way, by reducing the gut without drawing it down.* It is not sufficient to examine one end only of the loop; both should be seen, because the lower end is sometimes ulcerated. I have seen a loop returned whose upper end was sound, and when the down-rush of intestinal contents came, the lower end burst at the line of stricture, and caused fatal extravasation.

Treatment of the Omentum. After the surgeon has satisfied himself as to the state of the parts, he may proceed to deal with the omentum, when any is present. The omentum, in whatever condition it may be, is best taken away. If it is unsound, it must be taken away, and, even though it may be sound, its removal can do no harm, and makes certain that it can never again form the contents of a hernia. If it is in small quantity, with a narrow neck, it may be tied in a single fine silk ligature after it has been gently drawn down as far as it will come. If it is in large quantity, it is better to tie it in sections, so that it may spread out when it returns to the abdomen. It will also be remembered that, by making the ligature in one piece, a portion of bowel, hidden in the mass, has been accidentally tied and divided (page 112). The omentum is cut through about a quarter of an inch below the ligatures, and the stump is carefully looked over lest some vessel should have escaped from control or been torn during the manipulation above the ligature.†

Treatment of the Bowel.—The bowel is almost invariably beneath the omentum, and presents itself in one of four states—congested, inflamed, ulcerated, or gangrenous. There is no question about the fitness

* Mr. Bryant found that in nine-tenths of the cases of hernia (88), the ileum is the portion of bowel strangulated, and in three-fourths of these it is part of the last two feet. (Guy's Hosp. Rep., 1856, vol. ii. p. 84.)

† Desmoulin tied a piece of omentum in two parts with a double thread and cut it off. Bleeding took place from the stump, and the point was ligatured with catgut. In the evening bleeding occurred under the dressings. Sickness continued, and the patient died on the sixth day. Bleeding had taken place into the abdominal cavity from a vessel above the ligature.[39] A similar case occurred at St. Thomas's Hospital in 1887, where the incision at the operation was extended upwards for three inches, the stump of omentum pulled down, and an artery above the ligature found bleeding.

of the bowel for reduction when it is congested and the colour is not very deep. If it is black it must not be returned, but when it is deeply congested, yet not altogether black, the question of reduction is more difficult to determine. Cases were referred to in Chapter XXXV. in which a portion of bowel almost black had been known to recover, but this is a very exceptional occurrence.

When bowel strongly congested is returned, it is seldom that we are able to distinguish the disturbances which it is apt to excite, from those already caused by the strangulation before operation. But in some cases the return of very dark gut, even though the surface is still lustrous, is followed by gangrene, perforation, or peritonitis. There were twelve of the cases in Table XXXII. in which the bowel was stated to be "deeply congested," "dark," "blackish," and it was found at varying intervals after reduction perforated in five cases, gangrenous or sloughing in five, and in two cases peritonitis was set up. Eleven of these persons died, and one recovered. Burow returned a loop blackish brown in colour, but the peritoneal tunic appeared sound. After thirty-six hours a "colossal" mass of fæces escaped by the wound, an artificial anus spontaneously formed, and the patient ultimately recovered.[40] It is evidently very dangerous to return an intestine whose colour approaches nearly to black, and though it is true, as Aston Key said, that the abdominal cavity is the place where the injured bowel will be most likely to be repaired, yet it may do so much mischief there that it is probably safer to leave it in the sac. I will furthermore hazard the conjecture that the greater the length of the suspected bowel, the greater the danger of reduction. The temporary residence of the bowel in the sac is not in itself hurtful, for many hundred ruptures have the intestine down for days and weeks without evil consequences. If the stricture is freely divided, which is essential when the bowel is to remain in the sac, there can be little objection to leaving it there. In cases in which this question arises, the strangulation has generally been severe, and the patient may die of its effects, but the fatal termination cannot justly be attributed to the position of the bowel in the sac. According to the state of the intestine, as regards the probability of its recovery, the sac will either be closed by sutures throughout, or space will be left for a drainage tube which may be placed nearly in contact with its lower end.

When the Bowel shows signs of Inflammation of the serous coat, it might be feared that a general peritonitis would be set up, if it were returned to the abdomen, but the inflammation proceeding from this source is usually local, and of the adhesive kind.* Inflamed bowel,

* Mr. Holmes noted seventeen cases in which the gut was visibly inflamed. Five of these died of gangrene after reduction. In none of the rest did a fatal peritonitis follow reduction.[41]

therefore, if not too dark in colour, should be gently sponged and irrigated with an antiseptic solution and returned.

The case of ulcerated or gangrenous bowel will be considered later.

Reduction of the Gut.—To return the gut, the surgeon is generally directed to put back first that which came out last, but as there is no certainty, when a single loop is down, as to what part came out last, Petit varied the formula by saying, put back first that part which yields most readily.[42] The bowel is taken gently between the thumb and fingers a short distance from the ring, and small portions of it, 1 to 2 inches in length, are returned at a time. If there is difficulty, one end of the loop may be drawn out a little more, and an attempt be made by compressing the intestine to empty it of its contents, when reduction is likely to follow. Some surgeons approve of pricking the intestine to let out the gas and reduce its bulk, when there is difficulty in reduction. This is not necessary if the stricture has been sufficiently divided. The same proceeding for returning the hernia is effectual whether much or little bowel has descended.

Complete Reduction must be effected.—The stump of the omentum is returned after the intestine, and the finger should always follow the parts into the abdomen to make sure that they have really entered that cavity. By neglect of this precaution some serious accidents have happened. One of the forms of "réduction en masse" may be overlooked, or the hernia may be interstitial and the bowel have been merely driven into the abdominal portion of the sac, or it may still be held by an internal band, or it may have passed through a hole in the omentum and be still strangulated. If the finger is able to feel the back of the symphysis pubis and the border of the true pelvis, there is little doubt that the parts are in their proper cavity. After the viscera have been replaced, one or other of the operations for the so-called radical cure of hernia may be undertaken if the patient is in a condition to bear it. The wound is then closed with sutures, unless this is forbidden by the state of the gut, and no drain need be used, if the parts are sound and aseptic.

The Operation for Femoral Hernia.—A femoral rupture as it enlarges tends more and more outwards in most cases, and therefore the incision, which should be over the crural canal and ring, is made vertically along the inner part of the swelling. It should begin half an inch to an inch above Poupart's ligament in order that that structure may be clearly exposed near the neck of the sac. The skin and subcutaneous fat are first divided. After cutting through the deep fascia, the sac in its coverings can generally be isolated, shelled out, as Busch said, from the surrounding parts quite up to Poupart's ligament, and this it is more convenient to do at this stage than later in the operation. The layers

still enclosing the sac have now to be divided, and before coming down to it a layer of fat (subperitoneal) is often met with which tells of its close vicinity. As small femoral herniæ oftentimes do not contain fluid, the sac must be opened cautiously in the manner described for inguinal hernia.

The sac should be split from end to end, and the neck at the inner side carefully inspected. This often lies so deeply that it is hardly possible to see it without drawing aside the bowel to a dangerous extent. The left index finger is to be used to examine the stricture, and the bistoury passed along it, as before described, whilst the bowel at the same time is shielded. The bistoury should be carried past the stricture only just so far as to get beyond it, and the division should be made inwards, or inwards and slightly upwards through Gimbernat's ligament. To obviate the danger of wounding an aberrant obturator artery, Scarpa recommended that Gimbernat's ligament should not be divided, but notched in several places to a limited extent; this is the "débridements multiples" of Vidal de Cassis. This method appears to require a certain shifting of the knife whilst it is in contact with the bowel which is undesirable, whilst the danger which it is intended to avert, is rarely encountered. Verpillat (1834) suggested making the incision directly downwards into the "ligament of the pubes" at the ileo-pectineal line (see page 74). This would be a distinctly dangerous proceeding, because the obturator artery not unfrequently arises from the epigastric, and in turning over the border of the pelvis might be wounded by cutting downwards, and it is obvious that the vessel would be difficult to follow and to secure when pursuing this course. Hyrtl, and afterwards Busch, recommended making the cut by pressing, not drawing, the bistoury against Gimbernat's ligament. The resisting ligament parts before the knife, whilst the elastic, movable artery is pushed before it. Busch thought this all the more likely to succeed if the cut were made from the superficial to the deep surface of the ligament.[43]

The succeeding steps of the operation do not differ from those already described for inguinal hernia, and need not be retraced.

The Operation for Umbilical Hernia.—The operation for umbilical hernia is so fatal that if the swelling is large and the symptoms of short duration, an attempt may be made to return the parts, without opening the sac, after the aperture in the linea alba has been enlarged. For this purpose a vertical incision about three inches in length is made in the middle line at the upper edge of the tumour, and care must be used not to cut into the sac unawares, as its coverings are often very thin and intimately adherent to its serous lining. When the linea alba is exposed, the aperture in it should be enlarged directly upwards. Some have advised making the incision at the lower part of the hernia in order to

avoid the umbilical vein, which in very rare instances remains patent. The danger of wounding the vein is not worth consideration, but the operation performed at the lower margin of the hernia is difficult on account of the tendency of these ruptures to increase in a downward direction. If the sac must be opened, the omentum will probably be found adherent to it in several parts, or this structure may completely envelop the intestine. The subjects in whom herniotomy at the navel is done, are not well fitted for operation, and the omentum should therefore, if in good condition, be reduced rather than removed. If left in the sac it is likely to slough.

There is sometimes much difficulty in reducing the bowel because the soft abdominal wall yields before the pressure of taxis. Roser, therefore, suggested that the borders of the mouth of the sac should be held forward by blunt hooks in the hands of the assistant whilst the surgeon returns the intestine. If the patient can bear it, a radical operation can afterwards be performed and the wound closed.

The Operation for Obturator Hernia.—The operation for strangulated obturator rupture which has been most popular up to the present time, is that which was described in detail in 1812 by Hippolyte Cloquet.* A longitudinal incision is made in the upper part of Scarpa's triangle internal to the femoral vein, and the tissues are divided till the pectineus muscle is exposed. By now raising the knee and slightly rotating the thigh outwards, it is not difficult to separate the inner border of the pectineus from the outer border of the adductor longus. When these muscles are drawn asunder, the tumour presents itself in front of the obturator externus and adductor brevis muscles.†

The bowel is seldom adherent to the sac, and little difficulty has ever been experienced in reducing it. Several surgeons have been able to enlarge the obturator canal with the finger sufficiently to permit of reduction. When, however, the margin of the obturator opening or the neck of the sac requires division, and this may be deemed the safer course, some embarrassment may be occasioned by the irregularity in the position of the nerve and vessels before referred to. M. Trélat gives excellent advice on this matter, though in so deep a wound it may not be always practicable to follow it. He recommends that the vessels should be defined by dissection, and that the stricture should be divided at a part remote from them. If the vessels cannot be seen, they would run the smallest chance of injury by making the cut downwards and inwards.

There is perhaps no variety of hernia in which it is so important that

* An operation was performed in the last century by G. Arnaud on a young lady under the care of Malaval. There is some doubt as to the nature of the hernia and the steps of the operation.

† This operation was first successfully performed by Obré in 1851.

the surgeon should obtain a full view of the bowel as in this, for the strangulation is generally of long duration and of great severity. Even in operation cases it averages 7.3 days, and the gut suffers gangrene or ulceration in at least 38 per cent. But the operation, just described, does not enable the surgeon to examine the condition of the intestine with freedom, and cannot, therefore, be considered a prudent measure, unless the symptoms are mild and quite recent.

It was thought so difficult in the last century to reach the obturator foramen from the thigh, that Martini proposed to open the abdomen above the pubes in the middle line, and thus disengage the intestine.[44] This operation was again recommended in 1842 by Aug. Berard,[45] and was performed by Hilton in 1848 on a case in which the diagnosis was not established till the abdomen was opened. It was again performed in 1884 by Mr. Godlee. A writer in the *Gazette des Hôpitaux* for 1844,[46] whilst commenting upon a case which had died in the Salpêtrière, suggested that the abdomen should be entered above Poupart's ligament. The incision would be the same as for ligature of the external iliac artery, except that the peritoneum would be divided along with the other layers. It may be questioned whether an incision through the lower part of the linea semilunaris would not bring the foramen more clearly into view than any of those preceding. Through this incision the surgeon would probably be better able to make the manipulations needful for enlarging the neck of the sac or withdrawing the bowel, than from the opening in the middle line. And in giving facilities for other procedures which may be necessary when the intestine is gangrenous or ulcerated, this operation seems at least equal, if not superior, to that in the middle line.

The Operation for Ventral and other Herniæ.—It will not be necessary to describe the operation for ventral herniæ, which is done after the same manner as that for umbilical hernia. As regards the rarer forms of hernia, the mode of dealing with them when strangulated, has already been referred to in the First Part of this work.

The Frequency of the Occurrence of Strangulation among the Ruptured in general cannot be determined, but the frequency among them of strangulation that requires operation can be arrived at approximately. In Table XXXII. the inguinal and femoral herniotomies of the second decade, 1879 to 1888, show a proportion of one death to 1.92 recoveries; and among the cases in Tables I. and II. the number of recoveries after herniotomy was 225. Hence the number of persons who died after herniotomy corresponding to a total of 21,116 persons with groin ruptures can be calculated (=117). Therefore the proportion of herniotomies among those with groin ruptures is 1.6 per cent., and the death-rate .5 per cent.

Relative Frequence of the Operation in Groin Ruptures in the Two Sexes.—Again, as the mortality in inguinal and femoral hernia after operation is nearly the same when large numbers are taken (Table XXXII.), the relative frequency of herniotomy may be roughly estimated by comparing the numbers of patients who have recovered with the respective totals in Tables I. and II.* The result is that

.5 per cent. of male inguinal suffered operation.
5.2 .. .. femoral .. ..
.16 .. of female inguinal .. ..
8.1 „ „ femoral „ „

Here is seen the large proportion of herniotomies, that is, the greater tendency to strangulation in femoral hernia in both sexes, and the slight disposition to this accident in inguinal hernia, especially in the female.

The relative frequency of the operation may be deduced from Table XXXII. as follows. Among 100 operations are

	Per cent.
Male inguinal	37.5
Female „	4.8
Male femoral	7.9
Female „	49.5

The mortality for the whole period comprised by Table XXXII. is 37.2 per cent. for inguinal and 36.6 for femoral herniotomy. The mortality in the two decades taken separately is as follows:—

	First Decade, per cent.	Second Decade, per cent.
Male inguinal	40.2	35.6
Female femoral	40.6	35.1

The umbilical herniæ which were operated upon at St. Bartholomew's Hospital from 1869 to 1890 amounted to 44, of which 37 were in females, and 7 in males. Of these 22 died, which gives a death-rate of 53.6 per cent.

Causes of Death after Herniotomy.—Several factors concur to make the patient ill in strangulated hernia, and it is therefore difficult to state precisely in a tabular form the causes of death. The constriction of the intestine produces sooner or later more or less of that prostration, so often alluded to, which of itself is frequently fatal. The patient suffers in addition from obstruction to the passage of the intestinal contents, whose effects increase the depression under which he is labouring, and diminish his strength. The injury at the site of the stricture may

* Among the cases in Table I., 100 inguinal and 24 femoral had recovered after operation; and in Table II., 3 inguinal and 98 femoral had recovered after operation.

cause, without other lesion, a peritonitis, which intensifies or ushers in the prostration. The bowel may ulcerate and pour its contents into the abdomen, or after reduction it may mortify, and in both these instances peritonitis may be set up. And gangrene of the intestine within or without the abdomen may prove fatal without appreciable signs of peritonitis, or may terminate in artificial anus, and produce death by exhaustion. Thus it is seen that more than one fatal lesion may occur in the same person, and his death may be due to one or to a combination of all of them. And therefore a Table of Mortality constructed with every possible care gives but a vague and imperfect notion of the causes of death after herniotomy.*

The signs of peritonitis are present in a majority of fatal cases, and many deaths attributed to gangrene and perforation often come about from this cause. Next in frequency is prostration, which may accompany any of the obvious lesions, or be by itself the only explanation of the death. The cases of exhaustion mentioned in the Table were those who survived the operation for some time. It is not rare for the patient to be afflicted with diarrhœa after reduction of the gut, which may increase his depression or give rise to it. Such cases have been entered in the Table here given under the heading of exhaustion or collapse.

Septicæmia or pyæmia is rarely noted as a cause of death. Inflammation of the lungs and air-passages is not infrequent, but this likewise not seldom occurs when gangrene or peritonitis is present. The intercurrent diseases at the end of the Table have no obvious relation with the strangulation or the wound except the case of tetanus.

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2. **Ravoth.**—Berl. Klin. Wochensc., 1868, No. 22, p. 231.
3. **Kocher.**—Deutsche Zeitsch. f. Chir., 1877, viii. 443.
4. **Dieulafoy.**—L'aspir. des liq. morb., 1873, p. 190.

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* *Causes of Death after Herniotomy in Cases occurring in Table* XXXII.

Peritonitis	75	Brought forward	201
Perforation	10	Bronchitis, congestion of lungs, pneumonia	21
Gangrene	30	Diarrhœa and enteritis	2
Prostration and collapse	58	Bleeding from bowel	2
Exhaustion	13	Bed sores	2
Septicæmia or pyæmia	5	Tetanus, 1; mania, 1; hemiplegia, 1; nephritis and uræmia, 2; hæmatemesis, 1	6
Stricture unrelieved	4		
Wound of vessels	3		
Second operation	2		
Gut torn by taxis	1	Total	234
Carry forward	201		

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   Doutrelepont.—Ibid., 1876, p. 797.
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6. **J. Hern.**—Br. Med. Jour., 1891, i. 280.
7. **Hueter.**—Grundriss d. Chir., 1882, ii. Hälfte, p. 528.
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31. **Sonnenburg.**—Centr. f. Chir., 1870, p. 889.
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35. **Rigaud.**—Bull. Soc. Chir., June 2, 1875.
36. **Paul.**—Bull. Soc. Anat., 1858, p. 262.
37. **Malgaigne.**—Tr. d. Anat. Chir., 1859, 2nd ed., p. 277.
38. **Fergusson.**—Med. Times, 1850, xxi. 313.
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41. **Holmes.**—Op. cit., p. 317.
42. **Petit.**—Tr. Mal. Chir., 1790, ii. 326.
43. **W. Busch.**—Op. cit., p. 128.
44. **Martini.**—Quoted by Richter, Tr. des Her., ii. 238.
45. **Berard.**—Quoted by Vinson, De la H. souspubienne, 1844, p. 86.
46. **X.**—Gaz. des Hôp., 1844, p. 392.

CHAPTER XXXIX.

ON THE DIFFICULTIES OF HERNIOTOMY AND THE TREATMENT OF LESIONS OF THE BOWEL.

Difficulties in reaching the Sac.—The difficulties which may occur during the operation of herniotomy are of various kinds, and those will first be considered which present themselves whilst the incision is being carried down to the sac.

A layer of lymphatic glands often intervenes between the skin and the sac in femoral hernia, and may be of considerable thickness, as was before mentioned (p. 169), but they need not cause any embarrassment, as their characters are well marked and sufficiently well known. The subperitoneal fat sometimes lies in a compact mass over the sac, and may be covered by such a distinct membrane that when this is divided, the fat may be mistaken for omentum. The error is all the more pardonable as the fat is occasionally traversed by rather large veins which increase its resemblance to that structure. If it were omentum, no harm would be done by dividing it, and the surgeon has only to cut onwards and he will expose either the bowel or the sac. Moreover, this practice cannot be lightly disregarded, for in two at least of the cases in Table XXXII. the patient died because the subperitoneal fat, concealing the sac, was taken for omentum, and was pushed back into the abdomen with the bowel still in the grasp of the stricture (réduction en masse). In a woman with femoral hernia under Phillips, a tumour like omentum about the size of an egg was exposed. It was invested by a membrane, thought to be the sac, and when this was divided the mass was seen to be very vascular, with a large number of veins on its surface "so tortuous as to seem varicose." The tumour was turned up, but as no intestine was under it, the ring was enlarged, and it was reduced. After death a piece of gut was found in the centre of the fatty mass. The sac was closely united to the fat on one side, and to the bowel on the other.[1]

After prolonged taxis, a sero-sanguinolent fluid may be found between the sac and the subperitoneal fatty layer, and as this fluid much resembles that in a hernial sac, some doubt arises whether the serous cavity has not been opened. If the fatty tissue is divided from end to end of the wound, the difference between an unopened sac and intestine will probably be at once apparent. Instances of this anomaly are generally found

with femoral hernia, but Jobert quotes a case from Richerand of serosity between the tunics of the scrotum as well as in the sac.[2] The protrusion of a new sac into an old one which contains fluid (p. 92) occurs usually in femoral hernia, but there is not much likelihood that the true sac will be mistaken for intestine, if its line of attachment to the wall of the outer cavity is carefully traced, and if it is pinched up so as to glide over the underlying intestine.

Other Cysts occur which appear to be offsets from the sac itself, and either communicate with that cavity by a canal of variable dimensions, or are attached to its wall by a solid fibrous cord.[3] Sometimes one or more diverticula project from the sac. Neither these cysts nor pouches proceeding from the sac give rise to any difficulty, but it is far otherwise with those cysts anterior to the sac which are of uncertain origin. They were noticed by Sir Charles Bell, who likened them to hydatid cysts. They may be single, and form a large cavity, containing a thin, clear, faintly yellow fluid, in front of the hernia,[4] or they may be multiple. Stafford describes two such cysts, one apparently external, and one internal to the subperitoneal fatty layer;[5] but a still more remarkable instance occurred in the practice of Mr. Hulke.[6] During the operation for a strangulated femoral hernia in a woman, æt. 40, a 'glistening membranous bag came into view.' The stricture was divided without opening the sac, but reduction could not be effected. The membranous bag was opened, and serum escaped. The interior was a smooth-lined cavity 'whose posterior wall was convex, tense, elastic; in some parts blue and thin, in others glistening, white and tendinous.' It was overrun by a net of large veins. At first sight this resembled an ovarian cyst, but on tracing its convex surface, it seemed everywhere adherent at the periphery. It was opened, and a few drachms of clear serum were let out. In the floor of this second cyst a third, still deeper and distinctly limited, sacciform space was discovered which also contained serum. Through the posterior wall of this third cyst a small globular body about the size of a grape was felt, which proved to be the true sac. The difficulty in reaching the bowel in cases of Infantile Hernia has already been explained in Chapter XIII.

Fluid from the Abdomen escaping at the Wound.—The various conditions of the fluid contained in the sac have already been sufficiently considered (Chap. XXXV.). In rare cases it happens that a small quantity is found in the sac, whilst a large quantity flows from the belly on reduction. Baron Larrey described a case of this kind in which, as he was withdrawing his finger after returning the bowel, a stream of reddish fluid poured over his hand and arm and spirted on some of the assistants. One and a half litres flowed away at once, and during the first twenty-four hours the fluid soaked the dressings, the patient, and the bed.

This was thought to be an ascites with a strangulated hernia, and the woman recovered of both diseases at the same time.[7] In other cases the fluid appears to be an inflammatory effusion.

Adhesion of the Contents to the Sac Wall.—It may happen exceptionally that the intestine under the incision is so closely adherent to the sac wall that no distinction can be discovered between them, and the bowel is opened unawares. Desprès quotes a case in which Boyer (de Joinville) opened a hernia cutting through skin, sac, omentum, and intestine which formed such adherent and thin layers that the cavity of the intestine was incised.[8] It is obvious that the difficulty in such a case is very great, and I have seen a surgeon, constantly in the habit of operating, cut into the bowel, thus circumstanced, in mistake for the sac. This accident happened even to Baron Dupuytren. Some few of the herniæ of the cæcum and ascending colon are uncovered by peritoneum anteriorly, so that it would be prudent in a large hernia, when many layers have been divided without finding the sac, to renew the exploration towards the inner side of the hernia where peritoneum, if present, is most likely to be found. A case, remarkable in many respects, was reported by Mr. W. H. Bennett, in which he incised the coverings of a scrotal hernia, "and ultimately exposed a somewhat tense tumour, obviously containing fluid, which at first sight seemed likely to be the sac of the rupture, although it had not the appearance of such as commonly seen. Upon pinching up this apparent sac, there could be felt inside it a mass which slipped away from between the fingers, precisely as a tense knuckle of gut often does when felt in this manner inside a not very greatly distended sac." Mr. Bennett was fully aware that it was possibly the bowel itself with which he had to deal. This "apparent sac" was cautiously opened, and a quantity of clear watery fluid escaped. The fluid proved to be the secretion from an empty cæcum which had been strangulated at the internal ring, and contained an intussusception of the ileum through the ileo-cæcal valve.[9]

Before leaving the difficulties in recognising the sac, I may quote once more from Professor Albert a case from Linhart that exemplifies very well the deceptions to which we are now and then subject. A man with an old right scrotal hernia, after drinking a quantity of beer, was ejected from the public-house. He fell, and was taken to the hospital in Vienna. He presented most severe symptoms of strangulation, and the operation was therefore proceeded with. An opening was made into what was taken for the sac, and this was found to contain fæcal matters. The surgeon passed his finger far up the cavity and felt the ileo-cæcal valve. He therefore supposed that he had cut into a sacless cæcum. After death it was demonstrated that he had entered the true hernial sac. At the upper part of it was a portion of intestine which had burst,

and it was the opening in the torn intestine which had been mistaken for the ileo-cæcal valve.[10] In Mr. Bennett's case above quoted, it was noticed that when the contents of the cæcum escaped, its walls were seen to contract actively, and this would no doubt be a constant distinction between the bowel and some other cavity, unless the former had been so distended or otherwise injured as to be temporarily paralysed.

If there is uncertainty as to whether the sac has been reached, it generally only exists so long as the sac is unopened. Probably Maisonneuve's dictum is in most cases true, "If you are doubtful whether you have opened the sac, you may be sure that you have not opened it."

Wound of an Artery by the Division of the Stricture.—The wounding of a vessel during the division of the stricture in oblique hernia has been already considered, and needs no further comment. The epigastric artery is exposed to some danger in direct hernia when the incision is carried directly upwards, but few instances are to be found of this accident. When bleeding occurs from this cause in oblique or direct hernia, the incision must be enlarged upwards and both ends of the wounded vessel secured.

In femoral hernia an abnormal origin of the obturator artery places the vessel sometimes at the inner side of the neck of the sac, where it is liable to injury.* The observations of Cloquet and Quain have shown that this vessel arises from the external iliac by a common trunk with the epigastric in about one case in three. It was formerly supposed (Monro) that if this common trunk was short, the obturator descended to the pelvis at the outer side of the femoral ring, but if this trunk was of unusual length, the obturator passed down along the inner side of that aperture. But subsequently Quain showed that there is probably no connection between the length of the common trunk and the position of the obturator.[11] Lawrence calculated that the obturator would be in danger of division in femoral hernia in about one case in eighty. If the external iliac artery gives off the obturator directly, the latter vessel dips at once into the pelvis and skirts the outer side of the femoral ring. When an aberrant obturator is divided the blood may appear at the wound or may flow into the abdominal cavity.† In view of this possible concealment of the hæmorrhage, a surgeon in the last century invented a grooved director terminating in a little spoon, so that, when introduced into the abdomen through the ring, the blood would flow along its channel. A deep ordinary director suffices for this purpose.

* Monro says this was first observed by Wardrop.

† Bertrandi opened the bodies of persons who died a few hours after inguinal herniotomy, and found the abdomen full of blood from the wounded epigastric artery, though the operation at the time had apparently been successful. (Scarpa on Her., 1814, p. 125.)

In general a copious bleeding comes out at the wound, and steps must at once be taken to arrest it. Hyrtl advised drawing forwards the outer half of the split sac, to which the proximal part of the vessel is said to be closely united, when it becomes accessible to ligature. In most cases, however, it will be necessary to enlarge the herniotomy wound upwards in order to expose the bleeding points, and Poupart's ligament may have to be divided. Mr. Barker collected twelve instances of hæmorrhage apparently proceeding from this source, and seems not altogether to discountenance an expectant treatment in such cases.[12] There is no reason, as regards the patient, why the artery should not be sought and tied. If the objection to doing so is the difficulty encountered by the operator, this will be overcome by making the cut still more free in an upward direction.

Anomalies of the Omentum.—The omentum in a hernia sometimes forms a sac for the bowel, or the latter may pass through an opening in the omentum with indurated margin and be thus strangulated, or the omentum may be twisted round the bowel, and must be disengaged before reduction can be accomplished. Other peculiarities of this substance have been mentioned in the earlier part of this work, to which the reader is referred.

Wounds of the Intestine.—After taxis, the serous coat of the bowel is occasionally split, so that a little wound with nearly sharp edges appears in it which does not open its lumen. These gaps can be easily closed with one or more Lembert's sutures.

The surgeon may accidentally wound the bowel either in opening the sac or in relieving the stricture. The fact is made known by the bubbling of gas and escape of fluid at the part injured. When the serous coat alone is divided, the simple means just mentioned suffice to close it. If the wound is of small extent, but traverses all the coats of the intestine, a Lembert suture may still be used. When the bowel is little altered by congestion or inflammation, these wounds present no difficulty, but the tunics of the gut are at times so swollen, engorged, and friable that they will not hold a stitch. The case must then be treated as a perforation of the intestine, the management of which will be described on a later page.

Adhesions of the Bowel.—When the bowel is in a state fit for reduction, very little trouble arises in general from its adhesion to neighbouring parts, because the medium is of recent formation, soft, and easily broken down. The importance of completely releasing the bowel, both from its attachment to the sac and from adhesion of one part of the tube to another, has already been insisted upon. If the adhesion is organised, it may require dissection, and this should not encroach upon the layers of the intestine. It may be necessary to cut around an

adhesion and leave a piece of tissue attached to the gut. Mr. Treves met with a loop of colon attached to a portion of skin which he isolated, and, after removal of the epithelial surface, returned with the intestine to the abdomen without untoward result.* Very firm organised adhesions are not concerned in the strangulation for which the operation is done, and the question whether they should be left or dissected must be determined chiefly by the condition of the patient at the time. A group of intestinal loops may be closely adherent to one another without seriously impeding the course of the alimentary fluids. On the other hand, the peritoneal tunics of matted intestine may contract so much that the bowel is strictured in one or more places, and in such cases the propriety of excising the mass and restoring the canal by suturing the ends above and below the obstruction will have to be considered. The subject of suture of the intestine will be dealt with under the treatment of gangrene.

Difficulty of Reduction. Great difficulty is sometimes experienced in reducing the intestine, which in most cases may be got over by enlarging still more the size of the ring. There can be no objection to increase the incision upwards in inguinal hernia; in femoral hernia it may be necessary to divide the whole length of Gimbernat's ligament.†

In the Chapter on Interstitial Hernia attention has been drawn to the danger of resting satisfied with a reduction which is not altogether complete. If the protruded parts show a marked tendency to descend after they have been replaced, though no strong expiratory efforts are being made by the patient, the cause of this phenomenon must be ascertained. Many cases of interstitial hernia have been sacrificed from inattention to this sign, which should have led the surgeon to discover the strangulation still existing at the abdominal orifice of the sac.

In certain cases the obstacle appears to reside in the distension of the loops both outside and within the abdominal cavity. Under such circumstances, when a quantity of intestine in the sac is distended and irreducible, and when there is much meteorism, so that an enlargement

* A difficulty depending on adhesions is noticed by Dr. J. H. Hunt. A man had a large scrotal rupture as big as a child's head, which contained the cæcum part of the ascending colon and 8 feet of ileum. All these parts were closely adherent together, and formed an irreducible mass. He suffered strangulation several times, and at length died from this cause, when a piece of jejunum was found at the back of the sac, nipped between the ring and the irreducible matted intestines.[13]

† Mr. Hurry Fenwick met with so great an obstacle in operating upon a left scrotal hernia that he opened the abdomen in the middle line, and pulled up the intestine out of the sac from the interior of the belly. The sigmoid flexure was adherent along the lower margin of the inner ring, and when distended, it partly occluded that opening. The exact nature of the obstacle was not explained in this case, nor why enlargement of the herniotomy incision would not have sufficed for reduction.[14]

of the incision would probably give exit to more bowel without facilitating reduction, it would be prudent to follow Rosenberger's suggestion, and incise the most dependent loop. The gas and liquids can thus escape, and after the wound in the intestine has been closed, the protruded parts are easily returned to the abdomen. This expedient has usually been resorted to in large ruptures, and, among the cases collected by Fuhlrott, reduction was readily accomplished after the bowel had been emptied and no ill consequences ensued.

When about to adopt this measure, it would be necessary either to draw the loop which it has been decided to tap through an opening in a piece of rubber sheeting, or to pack around it very carefully with gauze to prevent contamination of the adjacent viscera. Rosenberger recommended that the incision should be small, something under 1 centimetre in length, and be made transversely to the axis of the gut at its free border. A large quantity of gas and fluid intestinal contents can be thus evacuated. When the stream has ceased to flow, the incision must be thoroughly cleansed and sewn up. If it is very small, a few Lembert sutures may suffice; but if it is as much as 1 centimetre long, it may be necessary to supplement these with a continuous suture in the mucous membrane. The intestines can now be easily returned, and that which has been wounded must be replaced last, and left near the mouth of the sac. This proceeding is of course very rarely necessary, and is justifiable only under the conditions pointed out by Fuhlrott, viz., when reduction is otherwise quite impossible, and when the walls of the intestine are still sound.[15]

Tapping and Draining the Intestine has been done from time to time for a different purpose than that of facilitating reduction. After obstruction has lasted some days the bowel above becomes overfilled and distended, and the longer the stricture is left undivided, the higher up along the intestine, as a rule, does this distension reach. When the part strictured is set free, it may still remain paralysed whilst the power of the distended bowel to drive its contents past this inert portion is partially or wholly suspended. In such a case the operation, though it relieves the gut from compression, does little to restore the current of the intestinal contents. The symptoms persist, and the patient may die of the obstruction though the bowel has been completely liberated. A patient in a desperate condition may yet recover after a copious evacuation of the gut. Sir Astley Cooper records a case in which, after six days' strangulation, the operation was done, and 4 inches of gangrenous intestine were removed. Yet the man was no better, and many hours afterwards, "when he appeared almost expiring, a sudden and violent discharge of air and fæces burst forth from the wound in immense quantity, to his immediate relief."[16] Such instances suggested the

propriety of opening the bowel by incision when it was much distended above the stricture. This was recommended by Desprès in 1843, on the ground that retention of the fæcal matters might lead to their escape by osmosis through the intestinal walls, whereby peritonitis might be set up.[17] The operation was successfully performed by Maisonneuve in 1844, and was again advocated by Vial in 1851 for the purpose of relieving the distension.[18] This measure, as applied to internal strangulation, has been practised and fully described by Mr. Greig Smith in his celebrated work on Abdominal Surgery, and still more recently in a paper read before the Medico-Chirurgical Society.[19]

It would be very desirable in strangulated hernia to procure an evacuation of the over-distended superior bowel if, as Mr. Bryant observed, a diagnosis could be made. It is not always possible during herniotomy to judge of the state of fulness of the bowel above the stricture, for it may be greatly overloaded without giving rise to meteorism. The method of incision and drainage is probably applicable to those cases especially in which there is meteorism, not depending upon peritonitis, and symptoms which have lasted some days. Mr. Greig Smith advises that after the incision, as above described, the fluids should be conveyed away by a suitable canula introduced into the bowel, to which a tube is attached. The gas and fluids in the vicinity of the incision escape spontaneously, but the emptying of the bowel further distant from the wound must be promoted by desiring the assistant "to gently knead the sides of the abdomen to force the fluids along the intestine and up to the opening." The proceeding occupies some time, and it may be necessary, if a thorough evacuation is attempted, to continue it for half-an-hour or even more. During this time Mr. Greig Smith recommends that the surgeon should sit down by the patient, and that the chloroform should be suspended. The wound in the gut, if made through sound tissues, can be closed in the manner already described, and the operation be then completed.

Lesions of the Intestine.—The lesions of the intestine which have still to be considered are due to ulceration or mortification, and it will be convenient to treat of them under two heads, according as the bowel has been perforated or not. When a whole loop or a large area of the intestine is gangrenous, it is universally agreed that it should be opened whatever subsequent proceedings may be adopted, and therefore gangrene of the whole calibre or of a large part of the tube comes under the class of lesions with perforation.

Lesions of the Intestine without Perforation.—The lesions without perforation are partial ulcerations of the wall of the bowel and gangrene of a single small area.

Ulceration extends in the majority of cases from within outwards, and is generally met with at the line of stricture. When the bowel

is drawn down for inspection, it is not always possible to be sure that ulceration of its deeper tunics has taken place. Sometimes there is obvious thinning at this part, and though the peritoneal surface is intact, the mucous and muscular coats are felt to be destroyed. A bowel in this condition is by some surgeons returned to the abdomen, and the affected part is placed opposite and close to the mouth of the sac, which is left open. It is hoped that adhesions will form between the intestine and abdominal wall which will prevent extravasation into the cavity of the belly if the base of the ulcer happens to give way. It has been shown by Scarpa and several of the great writers that the intestine, when reduced in a damaged condition, has little tendency to leave the neighbourhood of the hernial orifice, and that in a few hours it is fixed in that position by plastic adhesions. In rare instances, however, the intestine has fallen into the pelvis or receded from the ring, and if under such circumstances perforation occurs, the event is likely to be fatal. Ulceration once begun does not invariably heal after reduction of the gut, but may continue active for days or even for two or three weeks, and at length cause extravasation.* This case, like the previous one, is indeed rare; but in dealing with the individual we are not warranted in exposing him needlessly to risk, no matter how remote, and, therefore, when the question lies between returning the gut, thus injured, or leaving it in the sac, I must regard the second as the safer mode of treatment.† If the bowel recovers, it gradually retires within the abdomen whilst the patient keeps the recumbent posture, and if it bursts, the contents will escape externally.

When the lesion is not extensive, it may be sequestered by making a tuck in the bowel. On each side of the line of ulceration the serous membrane must be raised in a fold, and these are united by Lembert's sutures. The injured part is thus buried within the lumen of the tube, and if it gives way, no extravasation takes place. The bowel, treated in this manner, can be returned to the abdomen without fear of ill consequences. But invagination of the line of ulceration can only be done when the tissues in the vicinity are so far healthy that they are able to endure the strain of the sutures. In a case already

* Richet notes a case in which perforation at the line of stricture occurred on the fourteenth day after reduction.[20] Several such cases are given by Lawrence, among which is that of a woman from whom fæces escaped at the wound about the forty-second day.[21]

† When it has been decided to leave the bowel in the sac, a suture may be passed through its mesentery or through its superficial tunics to attach it to the side of the wound. Many have spoken for and many against this means of preventing the bowel from slipping back into the abdomen. The bowel at first has little tendency to move from its place in the sac, and after a few hours is fixed by adhesions, so that, unless the neck of the sac is very wide, the suture will not be necessary.

quoted, Mr. W. H. Bennett found at one part of the protruded loop a breach of surface involving the peritoneal and muscular coats. On account of the softening of the adjacent tissues the sutures tore through, and it was found that the opening could have been closed only by inserting the stitches at such a distance from the edges of the lesion that a "dangerous kink" in the bowel would have been produced.[22] In such circumstances the bowel must be left in the sac, or returned to the abdomen with the injured part close to the hernial orifice, and with a large drainage tube left almost in contact with it. This latter measure was adopted by Mr. Bennett, and though a fæcal fistula formed on the tenth day, it ultimately healed, and the woman made a good recovery.

When a Small Part of the Wall of the Intestine is Gangrenous at one spot, the diseased portion may be of such dimensions that it can be sewn into the lumen of the bowel by making a tuck, as above described. If it be too large for this, when the adjacent tissues are healthy, it may be excised, and the lips of the wound united by a double row of sutures, provided that the calibre of the tube is not thereby unduly contracted. Dr. Hallock Park found in the middle of a loop of congested intestine two gangrenous spots, each half an inch in diameter and about a quarter of an inch apart. The two were removed by a single elliptical incision whose long diameter ran diagonally to the axis of the intestine. The wound was closed by sutures, the bowel was returned, and the patient recovered.[23] It is evident that an incision, arranged in this way, affects very little the size of the tube when the edges are brought together.

Lesions of small magnitude, which have been now under consideration, were treated by the surgeons of the pre-aseptic days either by leaving the bowel in the sac, or less often by returning it to the abdomen just within the ring. Rovzing has estimated that in cases where the loop of intestine is apparently gangrenous, one-third die of perforation when the bowel is returned to the abdomen.[24] Excision of small portions of gangrenous bowel is not generally advisable, as was pointed out by Benno Schmidt and Albert,[25] partly because the surgeon cannot be certain of the actual extent of the lesion, and partly because there is danger of contamination of the wound by fæcal matters during the operation.

Lesions of the Intestine with Perforation.—When the bowel is perforated, the treatment will differ according as the opening is large or small. There has been much diversity of opinion as to the best way of dealing with small perforations. Velpeau was in favour of reducing the intestine in such cases when the opening in it was small, and the parts about it healthy.[26] His advice on this point met with much ad-

verse criticism at the time, and was afterwards qualified by him in great measure. Giraldès recommended in cases where the intestinal walls were not profoundly altered, closing the opening by suture (Gély's), and reducing the intestine.[27] Fine perforations in the groove, caused by the constriction, have been successfully treated in this way with Lembert's suture. This mode of treatment is subject to the condition, defined by Giraldès, which is unfortunately not generally present when the bowel is perforated. The parts in which the opening lies, are, as a rule, either obviously morbid without being actually gangrenous, or so far changed as to excite suspicion of their vitality. In this case the bowel cannot be returned, but unless the disease of the tunics is extensive, there is no need to lay it open. Either the perforation is closed by lymph and the bowel recedes, or a fæcal fistula forms and ultimately closes, or the damaged part mortifies and an artificial anus is established.

When a lesion of the bowel is at or above the line of stricture, and the protruded loop is in fair condition, the stricture will always be divided, because the surgeon cannot become aware of the lesion until that division has been made. Wherefore, however great the extent or severity of the damage at and above the ring, if there is not sufficient evidence in the sac to suggest it, the surgeon will necessarily liberate the stricture, whatever opinion he may hold as to the propriety of so doing.

It may happen that the bowel in the sac, though not gangrenous, is in a doubtful condition, and after division of the stricture the gut cannot readily be drawn down on account of adhesions near the ring. In such a case it may be deemed sufficient to release the bowel from constriction and leave the adhesions undisturbed. No doubt in some cases this would be a safe course to pursue, but it is not so in all. I have seen a surgeon, after enlarging the ring, omit to draw down the gut on account of adhesions, and in a few hours perforation occurred and a fatal extravasation. It is never safe in strangulated hernia to take for granted the condition of the gut. Verneuil during an operation found the gut in such a perfect state that he was almost annoyed at having decided to operate so early. After dividing the stricture he thought it not necessary to draw down the gut, but, as he was proceeding to dress the wound, a quantity of fæcal matter burst forth, and the bowel proved to be ulcerated.[28]

When the intestine in the sac is in a doubtful condition, the surgeon may suspect that the part within the neck is not sound, and will be unwilling to run the risk of tearing the gut by drawing it down. Under such circumstances, instead of dividing the stricture in the ordinary way, it would be advisable to cut down directly upon the neck of the sac, as Malgaigne recommended, whereby the bowel could be exposed

without previous disturbance. In inguinal hernia this proceeding offers no difficulty, and the operation can easily be converted into a herniolaparotomy; but in femoral hernia some surgeons might be unwilling to sacrifice Poupart's ligament, and would prefer either to open the abdomen in the middle line or by an incision above and parallel to the ligament. The latter enables the surgeon to seize the bowel immediately above the ring and prevent extravasation if it has given way, whilst no danger is incurred of infecting the general peritoneum by drawing a diseased intestine through that cavity to a median incision. Dr. Wyeth in a case of gangrenous hernia made the incision through the lower part of the linea semilunaris, and was able to arrive at the intestine with ease.[29] This incision appears preferable to any of those above mentioned. Whatever means are adopted to arrive at the bowel before disturbing it, the opening must be sufficient to enable the surgeon to clamp or secure the upper distended portion immediately above the ring. It is certainly very undesirable in view of future contingencies to make these large incisions, but when a serious lesion is present or likely to be present, the immediate object is to save life, and this overshadows all other considerations.

Large Perforations and Gangrene of the Bowel.—When there is a large perforation of the bowel in the sac, or ulceration in more than one place at the line of constriction, or gangrene of the whole circumference,* the cases are so nearly similar, as regards treatment, that they may be considered together. The protruded part is obviously unfit for reduction. There are then two principal modes of treatment, either to leave the bowel *in situ* and form an artificial anus, or to excise the damaged part, restore the canal, and return the intestine.

The formation of an artificial anus is in a great many cases soon followed by death, whilst of those who survive, the majority are healed spontaneously, but not a few are subject for a longer or shorter period to this disgusting affliction, and are at last exposed to the danger of a second operation for its closure. No such disadvantages attend the successful performance of primary resection and suture of the divided ends of intestine. The patient is at once set free from the effects of the lesion, the canal of the bowel is restored, and there is nothing to interrupt his progress towards recovery. And success will be most

* The frequency of cases of gangrene among strangulated hernia varies somewhat with different observers. Among 51 cases of Gosselin (1861), 13.7 per cent. were gangrenous.[30] Scholz gives 116 of Lorinser's cases (1844–1863), of which 14.6 per cent. were gangrenous.[31] Among 220 herniotomies by Hahn (1880–1888), 14 per cent. were gangrenous.[32] Professor Krumm cites 61 operations with 24.5 per cent. gangrenous.[33] Mr. Lockwood found 35 cases of gangrene or ulceration among 489 herniotomies performed at St. Bartholomew's Hospital between 1873 and 1889, which gives 7.15 per cent. as gangrenous.[34]

likely to follow this measure if the patient is still young and strangulation has not lasted long; if there is no collapse; if the tissues of the sac are sound,* and no symptoms of peritonitis are present. It is therefore in cases in which the local symptoms are severe, out of all proportion to the constitutional symptoms, that the method is specially applicable.

The first and chief difficulty which meets the surgeon who desires to perform primary excision and suture, is the general state of the patient. When ulceration or gangrene have taken place, the patient is usually in the lowest state of depression. Mr. Bryant has pointed out that two-thirds of these cases are moribund, and that therefore "only the minimum amount of operation can be performed upon them if they are to be given any chance of recovery."[35]

Primary suture has no power to dissipate the effects of the previous strangulation, and therefore, if this operation were to be used indiscriminately in all cases of gangrene, we could not look for much improvement in the results of the future over those of the past, however much the technicalities of the operation might be improved.[36] Primary union of the intestine is a complex, and therefore a long operation, varying, according to M'Cosh, from one to three hours, so that the shock may be very considerable in addition to that previously existing.[37] There are several difficulties also attending the operation which partly tend to lengthen it and partly to endanger its success. In the first place, the calibre of the bowel above is much larger than that below the stricture, and accurate union under such circumstances is so hard to obtain, that several ingenious plans, which will be mentioned later on, have been invented for equalising this difference. Again, the sutures do not hold well in the inflamed and œdematous walls of the superior gut, whilst they are also apt to give way because the exact limit of the gangrene cannot always be determined. It was partly for this reason that Kocher advised cutting very wide of the diseased tissue,[38] and the same author has shown that the danger of the operation is not materially increased by the greater length of bowel sacrificed.

The effect of stitching the cut ends of intestine together is to make a slight circular projection into the lumen of the tube along the line of suture. This diminishes the capacity of the tube, and forms more or less of an obstruction. If there is much distension of the superior bowel, this impediment increases the intra-intestinal pressure, which may burst asunder some of the stitches. This is one of the reasons why those who now advocate primary resection, have urged the importance of emptying, as far as possible, the upper distended bowel before beginning the

* If the sac, as well as the bowel, is gangrenous, primary reunion is generally deemed inadmissible.

reunion. This necessary outpouring of fæcal matters makes very difficult the subsequent complete disinfection of the coats of the bowel.

The nutrition of the gut is very liable to be deficient at the mesenteric attachment after primary reunion, so that a stitch frequently gives way at that part. This tendency to perforation is one of the chief dangers of the operation, and is very difficult to obviate. Schede proposed leaving the bowel in the sac, but Madelung pointed out that the perforation occurs not at the distal, but at the mesenteric border of the gut, and that therefore the effused fluids, instead of escaping externally, would more easily enter the abdomen. As a result of the failure of union at the mesenteric attachment, either a fatal extravasation takes place into the belly,* or a fæcal fistula forms. In Dr. M'Cosh's list of 121 cases at least 12 per cent., and in Mr. Makins' table of 55 cases at least 18.1 per cent., had fæcal fistula. If a patient, after the bowel has been united and returned, suffers, though but for a time, from fæcal fistula, it is only by a fortunate accident, as Madelung observed, that he escapes a fatal peritonitis.

Choice of Operation.—Notwithstanding all the difficulties and dangers of excision and primary suture, there would be no hesitation in preferring it, if the death-rate were less than, or even just equal to that for artificial anus.

But little is known of the comparative mortality of the two methods. Miculicz (Breslau) collected, in 1891, 173 cases of gangrenous hernia from different hospitals (Czerny, Riedel, Kocher, Hagedorn, Hahn, Poulsen, and himself), of which 94 had been treated by forming an artificial anus, and 67 by primary suture. The mortality among the first was 76 per cent., and among the second 47 per cent., and this comparison sufficed to convince Miculicz that primary suture should be the normal treatment in gangrenous hernia.[40] Still more recently, Mr. Lockwood collected 35 cases of ulcerated or gangrenous hernia from the clinical reports for seventeen years of St. Bartholomew's Hospital, all of which had been treated by artificial anus, and he found the death rate to amount to 88.5 per cent.[41] By comparing these with the mortality of cases treated by primary suture, derived from the tables of Mr. Makins and Dr. M'Cosh, Mr. Lockwood obtained a difference so largely in favour of primary suture that, like Miculicz, he recommended the method for general employment in gangrenous hernia. But without doubt both these writers present the case for primary suture more favourably, and for artificial anus less favourably, than they should. If the comparison between the death-rates in the two series were a just one, and supposing the rates were drawn from a

* The mucous membrane of the bowel above the stricture is sometimes ulcerated here and there, and after primary reunion, one of these ulcers has given way and caused fatal peritonitis.[39]

sufficiently large number of cases, the superiority of primary resection and suture would be demonstrated. But, as Mr. Treves has shown, the argument as it stands is quite fallacious. Mr. Makins' and Dr. M'Cosh's tables embody a collection of published cases, and these are notoriously unfit for statistical purposes of this kind, partly because they are selected cases, and because a certain number of fatal cases are naturally withheld from publication. Dr. M'Cosh draws attention to this, and considers the death-rate in his table (50 per cent.) far too low. The statistics of Miculicz are less open to objection, because they consist of a combination of cases from the hospital practice of different operators. But in these the operators sometimes formed an artificial anus, and sometimes performed primary resection, and we may be certain that they did not choose the most favourable cases for the first plan, and the least promising for the second. There is no considerable series of cases of gangrenous hernia in which primary resection has been rigidly applied to all, for comparison with another series in which every case has been treated by artificial anus. The statistics hitherto published only enable us to compare the worst cases with the best cases of a series. Thus all the tables of primary suture are partial towards that operation,* and must be regarded as defective in that all fatal cases are not included, and that the operation, even by its advocates, has been employed in a minority of cases of gangrene.†

The Rule of Treatment in London at the present day is to form an artificial anus. Many surgeons hold that this treatment is best for all cases of well-defined gangrene, whilst some are at the same time prepared to do primary suture in young and otherwise suitable subjects.‡

* The death-rate after primary resection, deduced from tables, subject to the defects mentioned in the text, have been investigated by Dr. Roman Baracz. He quotes from—

Jaffé	16	cases,	of which	50	per cent. died.
Rydygier	31	,,	,,	67	,, ,,
Madelung	44	,,	,,	52	,, ,,
Makins	55	,,	,,	52	,, ,,
M'Cosh	115	,,	,,	50	,, ,,
Reichel, who adds Rydygier's and Madelung's cases	56	,,	,,	54·5	,, ,,
Barette	49	,,	,,	47	,, ,,
Mazzoni	20	,,	,,	40	,, ,,

The rates here given, which range from 40 to 56 per cent., are necessarily much below the true rate, as Dr. Baracz observes.[42]

† Professor Krumm points out that of fifteen cases of gangrenous hernia under Czerny, who is an advocate for primary suture, only four were treated by primary suture.[43]

‡ Of twenty-one London surgeons who have expressed their views upon this subject in public of late years, seventeen are in favour of forming an artificial anus, and four of doing primary suture.

The reasons generally given for rejecting primary suture are that the patient is seldom in a condition to bear a prolonged operation; that the method does not afford facilities for emptying the overloaded upper bowel; that there is no certainty as to the exact limits of the diseased area; that there is great risk of extravasation from sloughing, or bursting of the line of suture, or from gangrene of part of the replaced gut; that there is great difficulty in carrying out the technical details on account of the inequality in size of the two portions of intestine; and that it is almost impossible to keep aseptic the parts which must be handled for an hour or still longer.

There are two principal modes of forming an artificial anus. In the one the bowel, after it has been exposed and found to be gangrenous, is incised, the stricture is or is not divided, and the case is then left to Nature. In the other the stricture is divided, the bowel is drawn down, the gangrenous parts are cut away, and the ends fixed in the wound by sutures. It is of great importance that the suturing should be done with great exactness, so as to prevent contamination of the peritoneal cavity by fæcal matters in the wound. In passing the sutures Mr. Treves directs that the needle should be entered first in the skin and be brought out through the mucous membrane, lest, by carrying it the reverse way, the tissues outside the lumen should be infected by intestinal contents. For the same reason a fresh needle should be used for every stitch.

Whether the Stricture should be divided or left untouched are questions which have given rise to some controversy. Those who disapprove of enlarging the hernial aperture, fear to disturb the adhesions that may possibly exist on the abdominal side of the ring which, it is supposed, serve to protect the peritoneal cavity from infection by the putrid parts in the sac. On the other hand, if the stricture is not divided, the whole extent of the gangrene is not known, and the distended bowel above may not empty itself, and the patient may die unrelieved. In some cases, after mere incision of the bowel, the fæces flow freely, and there is no necessity to enlarge the ring so far as the relief of obstruction is concerned. In other cases there is no escape after the loop is opened on account of the paralysis of the distended bowel above, even when the ring has been freely divided. Le Dran, Pott, Astley Cooper, Aston Key, Dupuytren, Erichsen, and others advised division of the stricture. Lawrence and Gosselin also enlarged the ring if the fæces did not flow easily. Of late years Mr. Mitchell Banks, whose utterances are always received with attention, has condemned division of the stricture,[44] and Mr. Jacobson and Mr. Treves in their works on operative surgery have acquiesced in this opinion. Mr. Mitchell Banks appeals to experience to show the futility of the practice, "for in a very short time

both flatus and fæces find their way out." But experience in all that concerns gangrene of the intestine is very limited. The thirty-five cases collected by Mr. Lockwood, above referred to, were drawn from the records of seventeen years, which, as Mr. Treves has pointed out, give about two cases for each year; and if these cases are divided by the number of surgeons at St. Bartholomew's Hospital, the individual experience of each surgeon at that hospital, which is otherwise provided with an immense clinical material, must be very slender indeed. It is much to the credit of the profession in London that this should be so, for it is evident that in a given place, the higher the average of surgical ability, the smaller will be the number of cases of gangrenous hernia. The great diversity of opinion on certain points in the treatment of gangrene is due no doubt to the small experience possessed by each individual surgeon. Experience, so far as it can be obtained from published records, does not wholly bear out Mr. Mitchell Banks' assertion.

Cases are met with in which, when the stricture is not divided, or is imperfectly divided, no fæces escape. Instances of this are found in Mr. Lockwood's list.* One is mentioned in the Statistical Report of University College Hospital (1885) where no division of the stricture was made because a director passed freely into the bowel. No fæces came by the wound, and the gut was found post-mortem greatly distended above the ring. In two cases of Professor Kocher's no fæces would flow until the stricture had been divided. In another case of the same surgeon the lower end of the intestine could be easily explored, but the upper end at the ring was closed. In still another case, after the bowel had been laid open without dividing the stricture, a catheter was passed apparently into the upper end, but nothing came away. After death the upper end was found closed at the ring, and the catheter had entered the lower portion of intestine.[45] Five cases are referred to by Körte in which no fæces flowed at first, and the stricture had to be subsequently enlarged. Even when the stricture is divided, the fæcal matters will not always flow on account of the paralysis of the distended intestine. Mr. Lockwood gives three cases (Cases 3, 6, 9) in which this happened, and Professor Kocher [46] describes a case where nothing came from the bowel though a catheter had been introduced. It is not necessary to quote more instances to show the propriety of dividing the stricture, if not in all cases, at all events when the fæces do not flow freely.

But the Danger of leaving the Gut without Examination of the parts beyond the ring is also very great. Perforation is apt to occur, with or without division of the stricture, if the bowel is left to the care of adhesions. Pelletan mentions a case,[47] and in Mr. Lockwood's list, Cases 4, 14, 18, 26, and 31 are apparently of this nature. Professor

* In Case 5 no fæces passed till the fifth day; and in Case 11 no fæces passed at all.

Kocher gives an instance,[48] and Körte also, and two of the cases in Table XXXII. were of this kind, one at University College, and one at St. Thomas' Hospital. Mr. Mitchell Banks treated six cases of gangrenous intestine by laying open the bowel and leaving the stricture untouched. Three recovered well, two were moribund at the operation, and the last suffered perforation on the sixth day at the abdominal side of the stricture.[49] It is thus evident that in a certain proportion of cases a fatal extravasation will ensue, if the intestine remains undisturbed, and in a still larger proportion obstruction will continue whether the stricture is left or is divided.

If by leaving the bowel *in situ* we could protect the patient from the danger of infection of the general peritoneum, he would still be exposed in many cases to the risk, at least equally great, of dying from unrelieved obstruction. For my own part, I do not perceive how these dangers can be obviated, unless the gangrenous parts are removed, and the bowel is drained. For this purpose the stricture must be fully divided, the bowel set free and brought down, and the damaged parts removed, so far as they can be recognised. If the faeces do not flow, the upper bowel must be intubated, washed out if need be, and otherwise solicited to act after the manner suggested by Mr. Greig Smith. The edges of the intestine can then be sewn to the sides of the wound so as to exclude it from communication with the abdomen.

Mortality after Artificial Anus.—The deaths which occur after the formation of artificial anus have been classed by Haenel[50] as those which follow soon after the operation, as a consequence of the previous strangulation, and those which happen later from inanition, due to the great loss of alimentary matters. In Mr. Lockwood's list 21 persons died within three days, and may be considered as coming under the first of the above divisions. This agrees very well with Mr. Bryant's estimate that two-thirds are dying at the time of operation. Of Mr. Lockwood's 10 remaining cases all died within fourteen days except one, which lived just over a month. In 19 of the fatal cases in Table XXXII., 10 died within twenty-four hours, 8 died in the first twelve days, and one after living for five months died from an operation undertaken for the restoration of the canal. The fatalities which occur within the first fortnight are for the most part due to perforation, peritonitis, or exhaustion. Those who survive the immediate effects of the strangulation are in danger of dying from marasmus, on account of the escape of the intestinal contents, and this danger is the greater, the nearer to the duodenum the opening is situated.

The abdominal wall about the artificial anus may inflame and suppurate, whilst almost constantly the skin becomes eczematous. This eczema may spread over the whole body. In a few cases the end is brought

about by erysipelas or blood-poisoning. A small fraction of the survivors die after operations performed to close the opening in the bowel. And when spontaneous healing has taken place, the cicatrised bowel has sometimes contracted, and death has been caused by bursting of the gut above the stricture.

Symptoms and Course of Artificial Anus.—Whether the artificial anus is formed by the surgeon or by the spontaneous opening of an ulcerated or gangrenous bowel, the appearances in the two cases are ultimately identical. The sloughs separate, and the opening becomes daily more defined, through which the alimentary fluids and gases escape involuntarily in an intermittent stream. The cutaneous opening is generally single. In a case seen by Cruvelhier, the orifices of the two portions of intestine were separated by a band of skin, and the same observer notices that there may be three openings at the surface.[51] Körte quotes a case from Morse in which two loops of bowel had perished, and there were four intestinal openings in one external aperture.[52] The two ends of the bowel have no constant position in the cutaneous orifice, for sometimes the upper extremity by which the fæcal matters escape is external, sometimes internal, or at any other part of the contour. When cicatrisation is complete, the mucous membrane becomes continuous with the skin at the edge of the opening. The gap when viewed from without has a rounded or irregular outline, and is generally depressed in the centre. The sides of the excavation are shelving, and formed of puckered, swollen, and inflamed skin. The continual moistening of the surface with alimentary fluids causes eczema of the skin, and this may also undergo partial digestion. Hence in certain cases the artificial anus is extremely tender, and the patient cannot tolerate any pressure on the part.

Prolapse of the Intestine.—In such persons the intestine is apt to protrude, as it may do in others in whom this singularity is not present. Sabatier especially drew attention to the tendency of the bowel to prolapse, and gave instances in which one or both ends of the gut protruded.[53] Sometimes the mucous membrane alone descends and forms a circular, congested swelling of small dimensions. When the bowel itself prolapses, if the lower end comes down, the fæcal matters escape at the cutaneous orifice, and, if the upper end comes down, the fluids flow from the opening in the extremity of the inverted intestine. Le Cat and some others have described prolapse of both ends of the gut. A portion thus protruded has been known to become strangulated in the abdominal orifice, and to have been reduced by operation,* or to have perished from gangrene. Cruvelhier has pointed out that

* Veiel operated to reduce a piece of intestine thus inverted. (Arch. Gén. de Méd., 1835, 2nd ser., vol. vii. p. 542 ; also quoted in Velpeau's Op. Surg.)

a portion of intestine which has been strangulated and has escaped destruction, if it remains exposed, may be mistaken for a prolapse.

Reduction of the Invagination is essential before either spontaneous or surgical cure of the artificial anus can take place. The upper end, when prolapsed, is usually reduced easily by pressure, or returns of itself when the patient is recumbent. The lower end is more difficult to replace, and in neglected cases may resist all attempts at reduction.

Pathological Anatomy.—When an artificial anus heals spontaneously, the stream of intestinal contents becomes less and less, till the opening is reduced to a fistula, which, after discharging for a time a thin fluid, with or without fæcal odour, at length closes. In the case related by Scarpa, upon which he founded his description of the pathological anatomy of this affection, a fistula was still remaining. "The great sac of the peritoneum had not only become firmly adherent to the portion of the intestinal tube which had been unaffected by the gangrene behind the inguinal ring, and properly speaking in the cavity of the abdomen, but likewise that this sac of the peritoneum, like a membranous *funnel*, extended from the cavity of the abdomen through the inguinal ring into the fistulous tube, communicating externally by a narrow hole in the groin. And there could be no doubt that this membranous *funnel*, formed by the great sac of the peritoneum, was the same which previously formed the hernial sac. . . . The two orifices of the intestine had remained in a direction parallel to each other, and without being at all turned towards one another, and a ridge projected between them, which of itself alone would have been sufficient to prevent the direct entrance of the fæculent matter from the superior to the inferior orifice. . . . It was not difficult to comprehend that the alimentary matters had been poured from the superior orifice of the intestine, first into the membranous *funnel* formed by the remains of the neck of the hernial sac, then from this by a half circle into the inferior orifice of the intestine."[54]

Scarpa afterwards adverts to the tendency which the two segments of intestine have to retire beyond the ring towards the abdominal cavity, though preserving their adhesions to the neck of the sac. This movement materially aids the formation of the membranous *funnel* which is so important in restoring the channel for the intestinal stream. Furthermore, Scarpa pointed out that the communication between the upper and lower ends of the intestine "would take place more readily the smaller the loss of substance of the intestine, when only one-third of its circumference, for example, was destroyed. Because in this case, however small the retraction of the neck of the hernial sac towards the abdomen, the resulting membranous funnel is always sufficiently large to supply the want of a third of the side of the intestine destroyed. In other cases in which the sphacelus has destroyed the whole loop of pro-

truded intestine, as the two orifices touch each other on one side, almost in a parallel line, and form a very acute angle on the side next to the mesentery, the promontory which rises and projects forwards between the two apertures of the intestine, entirely prevents direct communication between them." The promontory, which has been termed éperon by the French, is composed of the walls of both ends of the intestine where they are adjacent and adherent. Directly strangulation occurs, the lower portion of bowel begins to contract, so that from the first there is inequality in size between the upper and lower intestine above the ring. When artificial anus has been established, the lower portion of gut contracts still more, till at last, if the case is of long duration, its lumen may be less than that of a goose quill. The upper portion of gut, on the contrary, as its function continues, is dilated and vascular. The constant passage of fæcal matters through it tends to protrude its orifice, and to lengthen the promontory or spur. The latter may increase downwards to such an extent as to shut off completely the orifice of the lower bowel from the cutaneous opening. Hence the great difficulty which is sometimes experienced in finding the lower opening.

If a part only of the circumference of the tube has been destroyed, there is no spur, but a convexity of greater or less prominence opposite the opening in the intestine. In any operation, therefore, for closing the intestine, which consists in reducing the spur, it is important to ascertain clearly whether the case is one in which a spur exists.* Dupuytren was the first to perceive the necessity of destroying the spur in order to permit the alimentary matters to flow directly from the upper to the lower orifice of the intestine, and his method is still the safest and most popular of all the curative operations for artificial anus. When he first conceived this design, Dupuytren had an instrument made with which to cut out a piece from the partition between the two portions of intestine, but before he made use of it, he recognised that if the two parts were not adherent, a fatal perforation might be produced. He at once abandoned his intention, and after further trials,† constructed the instrument which goes by the name of Dupuytren's Enterotome.[56]

Dupuytren's Enterotome.—The object of this Enterotome is to destroy the spur gradually, and, in doing so, to create a local peritonitis which

* Cruvelhier cites a case in which a surgeon who tried to destroy a spur which did not exist, caused fatal perforation of the intestine. In some cases the two ends of bowel are completely free, and yet no infundibulum is present.[55]

† Dupuytren passed a seton through the spur in one case, and gradually increased its size till at length the border of the spur gave way. As the ends, still remaining, appeared to create some obstruction, Dupuytren removed small portions with scissors. After one of these removals the patient developed acute peritonitis and died. It was this case which suggested to Dupuytren the idea of his Enterotome.

shall unite the adjacent serous surfaces of the intestine, if they are not already adherent, and thus obviate the danger of perforation.

The instrument consists of a pair of forceps with straight blades, whose opposing surfaces are undulated so as to take a firm grip. One blade is passed into each open end of the intestine, and the intervening spur is compressed between the blades for a space of 3 to 5 centimetres. Körte recommends that not more than 1½ to 2 centimetres should be included at one time. The blades, which are daily approximated by means of a screw through the handles, crush through the spur in a period which varies from four to ten days. Dupuytren's instrument has since undergone various modifications, of which the most valuable appears to be that of Gross. The blades are made to end in two flattened rings, which, as they come together, separate all that part of the spur which is within their area.

Fæcal Fistula.—Before employing the Enterotome certain minor measures may be tried. Many cases of false anus heal spontaneously, becoming first fæcal fistulæ, and then closing altogether. According to Dupuytren, three-fourths of the cases heal spontaneously. It is well, therefore, so long as the patient's nutrition is good, to give Nature a fair trial. Light pressure over the cutaneous opening assists the closure of the bowel, but this must be used with caution whilst the cicatrix is still young. At the same time the patient should be fed as much as possible with dry food, and purgative enemata may be administered. If the false anus heals up leaving a fistula, or, if the case is throughout one of fæcal fistula,* it can often be closed by putting on a truss and letting the patient follow his vocation. Several fistulæ, despaired of by the surgeon, I have seen heal in this way at the Truss Society. If the fæcal fistula remains persistently open, its channel may be refreshed with the galvano-cautery, or the sides of the opening may be pared with the knife and the raw surfaces united with suture or hare-lip pins.

Mitchell Banks' Method.—When the false anus shows little disposition to close, the spur may be obliterated by introducing a piece of wide rubber tubing into the two ends of the intestine, as recommended by Mr. Mitchell Banks. The tube is introduced in a bent position, and, as it tends to straighten itself, presses constantly against the spur. To the middle part of the tube a ligature is attached by which it is withdrawn; but in one case Mr. Mitchell Banks found the cutaneous opening had contracted so much during the residence of the tube in the bowel that it was only removed with great difficulty. In such a case he advises cutting the ligature and allowing the tube to find its way to the anus.

* Dieffenbach says that artificial anus is more common with inguinal and fæcal fistula with femoral hernia. (Op. Chir., 1848, ii. 586.)

The Application of the Enterotome.—If it becomes necessary to resort to the Enterotome,* this should not be used till at least two months have elapsed since herniotomy. The operation must not be attempted, according to Körte and Von Bergmann, till three months have passed, when it is possible to wait so long, in order that the adhesions may be firm, and the wound so quiet as to be able to bear a fresh irritation. The objections to waiting are, firstly, that the nutrition of the patient may suffer. If the false anus is in the jejunum or upper part of the ileum, it will be needful on this account to adopt some more expeditious means of restoring the continuity of the intestine. Secondly, the lower end of the bowel is more contracted, the longer the operation is deferred.

Before applying the Enterotome, steps must be taken to enlarge the portion of bowel between the false anus and the rectum. Copious injections of warm water are made from the artificial opening as well as from the true anus. Dieffenbach recommended for this purpose enemata of beer, containing much gas, to produce a flatulent distension of the bowel. A more elegant and probably far more efficacious plan would be the insufflation of hydrogen gas, as proposed by Senn for another purpose, for with this the pressure can be regulated at pleasure. Reichel considers it advantageous, when making the artificial anus, to insert a large drain tube into both ends of the intestine in certain cases. The tube in the lower ends is to be used for introducing fluid foods, and to prevent the bowel from contracting.[57]

Körte draws attention to the fact that the two ends of intestine are not always accessible, but at times are buried beyond long, devious fistulous tracks, as is likely to be the case especially when spontaneous healing has made progress. The Enterotome cannot be safely used until both ends of the bowel are completely within reach, and consequently some preliminary operation may be needed to open the way to them. The fistulous passages must be divided or gradually dilated with bougies, gum elastic canulas or sponge tents, as recommended by Velpeau. When the existence of the spur and its position have been clearly ascertained, its destruction can be undertaken. One of the different forms of Enterotome is usually employed; Bruns used the thermo-cautery.[58] Excision or ligature have not proved very safe.

The Enterotome must be applied to small portions (1½ to 2 centimetres) of the spur at a time, and must be screwed up so as to hold the included part firmly. It should not be so tight as to be very painful, and it must

* For the following remarks concerning the management of the Enterotome I am principally indebted to the works of Dupuytren, W. Körte, Professor E. von Bergmann, and C. Koch.

be loosened if it causes much distress.* The direction and position of the instrument must be preserved by means of lint pads and strapping. As the pinching of the spur causes peristaltic action of the intestine, a dose of opium should follow the operation. Every day the blades should be slightly approximated until division is effected, which happens between the fourth and tenth days. The instrument has to be used from two to six times, but the application must not be repeated, according to C. Koch, until the wound of the mucous membrane is completely cicatrised. When the alimentary fluids begin to pass directly into the lower bowel, the cutaneous opening begins to contract, and may close without further interference. In other cases another operation may be required to occlude the fistula that remains. This can be done with the cautery, by freshening and suturing the edges, or by a more formal plastic operation.

Closure of the opening by superposition of a flap is indicated, according to Dieffenbach, in those cases where either the loss of skin has been considerable, or the borders of the opening are composed of thick, hard, ill-nourished scar tissue. The first operation of the kind was performed by Collier to close a false anus which had followed the incision of a strangulated hernia in mistake for an abscess.[†] Dieffenbach transplanted a flap from the vicinity, attached by a bridge of skin, and united it by sutures to the freshened margins of the opening, except at the lower part, which he left open for the escape of faecal matters. This opening was afterwards closed. Mr. Greig Smith advises making "the flaps—one turned on its face over the opening, and the other laid by its raw surface over the surface of the first."[‡]

Partial Secondary Resection of the Intestine. It may be necessary to perform a more extensive operation, as in some cases, though the spur has been completely destroyed, the faecal matters do not pass along the lower bowel. A partial resection of the intestine can then be done. The mucous membrane at its junction with the skin is separated and dissected up for some distance, till its edges can be inverted and its outer raw surfaces united by sutures. The margins of the skin are then sutured, or, if the gap is wide, it may be needful to take flaps from the neighbourhood to close it.† This operation has been frequently performed with success. In a work already referred to, Körte describes four cases thus treated. In a case under Mr. Howard Marsh, in which no fæces passed by the rectum during the month after destruction of the spur, the intestine was found "adherent merely to the edges of the

* The application of the Enterotome is sometimes followed by colicky pain in the abdomen, sickness, and restlessness.

† The chief features of this operation were described by Léotard in 1840. (Verneuil, Bull. Soc. Chir., 1871, p. 288.

external wound, so that, when this connection was separated, the gut was quite free within the sac. The intestinal fistula was closed by Lembert's method, the bowel returned into the abdominal cavity, and the edges of the external wound were brought together." [61]

Carl Koch describes an operation which he performed to close an artificial anus, after the spur had been removed by several applications of Dupuytren's Enterotome. The mucous membrane was dissected at the line of junction with the skin, and an attempt was then made to separate the serous surface of the gut from the remnants of the sac. The gut was followed up to the abdominal cavity, and, after all adhesions had been divided, was drawn down into the wound. The cicatricial ring at the opening into the gut was next cut away, and the edges then closed by Czerny-Lembert sutures. Koch recommends that the suturing should be made in the longitudinal direction of the intestine.[62] This method, which does not differ essentially from that previously used by Czerny in 1877,[63] as it does not encroach upon the mesenteric border of the bowel, is a much milder measure, as Koch points out, than secondary resection. Meusel in two cases cut vertically into the abdomen above the fistula, and after seizing the intestine, separated it from its adhesions and from the fistulous opening. He then closed the aperture in its wall, which was not large, with Lembert's sutures in the direction of its longitudinal axis, returned the gut, and closed the wound in the parietes.[64] In those cases in which there is prolapse of the intestine, reduction must be effected before the Enterotome can be employed. When the lower end of the bowel is invaginated, it may be irreducible. Under these circumstances Velpeau and Panas removed the external portion with the Écraseur, and subsequently applied the Enterotome successfully. This method has been since used by M. Verneuil with good result.[65]

The Mortality after the use of the Enterotome amounts to 8.4 per cent. according to Heimann,* and 9.9 per cent. according to Körte.[66] The latter quotes 111 cases in which this proceeding was instituted, with 11 deaths. Five of them were the immediate consequence of the operation, whilst the remaining fatalities were less directly dependent upon the use of the Enterotome. According to Körte, 63 per cent. completely recover soon after the operation. In 30 of Körte's cases a fistula was left. I cannot regard this as a matter of much consequence, for many such fistulæ close later on after the patient has discontinued his visits to the surgeon.

Total Secondary Resection of Intestine.—In certain cases the Enterotome cannot be used, or fails in effect, and it is then necessary to restore the continuity of the intestine by some other means. If the opening is

* Several of Heimann's cases were apparently false anus following wound, and if this be so, his statistics are of no value in the present context.

in the jejunum or upper part of the ileum, the nutrition of the patient is wont to diminish so rapidly that the artificial anus must be closed without delay. In some cases, as Helferich points out, the loss of strength declares itself quite suddenly and unexpectedly. The lower portion of intestine beyond the fistula may be impassable from various causes. It may be so bent, "kinked," as it is called, and fixed by adhesions, that its lumen is closed. Dr. Thomas Sinclair met with this anomaly, together with a stricture of the intestine, "caused by the earlier strangulation," in a case successfully treated by Enterectomy.[67] An instance is given by Delpech in which the lower end was placed above the upper and twisted around it.[68] In an artificial anus of long duration Tauber found septa and valves in the lower portion of intestine which made the gut impermeable, though for the first few centimetres from the outer opening the calibre was wide.[69]

When, moreover, the Enterotome has been applied several times, and plastic operations have failed to close the fistula; when there is prolapse which cannot be reduced or safely removed; when the lower end of intestine cannot be found; when also symptoms of cicatricial stenosis of the intestine are noticed, the case is not curable by Dupuytren's method. But considering the high mortality which attends direct union of the intestine, all minor measures should be tried when practicable, before this one is undertaken. Makins' statistics of secondary resection show a mortality of 38.4 per cent.,[70] Haenel's 37.2 per cent.,[71] Reichel's 37.8 per cent., and Hertzberg's 27 per cent.[72]

The Preparation of the Patient, which is of equal importance whatever plan is used for restoring the continuity of the bowel, is directed to procure an aseptic state of the parts to be united, and, if possible, to fortify the patient's strength for the shock of the long operation. Little can be done towards the latter object when the fistula is high up on the intestine, and the lower end is closed. If both ends are patent, something may be effected by feeding through the lower one with peptonised foods. When the fistula is near the cæcum, the nutrition either suffers not at all, or can be readily improved, as a rule, by careful feeding. Attention must be given in good time to dilating the bowel between the true and false anus. The various expedients for this purpose have been already described.

To obtain a pure field of operation the patient is purged several times during the preceding week or ten days. The diet is fluid, chiefly of milk, beef tea, and eggs. The eczema may heal spontaneously during this period, or it may be needful to apply some local remedy. Dieffenbach used fomentations of lead lotion and emulsion of quinces. In the case described by Mr. Makins, which is now so justly celebrated, the eczema covered an area equal to one-third of the abdominal surface,

and this was "very materially improved" by placing a shield around the orifice during the week before operation, and causing the intestinal fluids to be mopped up constantly with absorbent wool.

In the last twenty-four or thirty-six hours food by the mouth is withheld altogether, whilst nutrient enemata are given every four or six hours. The lower and especially the upper intestine are now frequently washed out with warm water. It is not advisable to irrigate the bowel during or immediately before the operation, as peristalsis is thereby set up. Opium should be administered the previous night and before the operation to lessen the vermicular movements.

On beginning the operation of **Resection**, the upper end of the intestine is provisionally closed with a captive sponge, and the field of operation is diligently made aseptic. In some cases, by cutting around the edges of the fistula and into the remains of the sac, the bowel can be freed from its attachments and drawn down through the hernial orifice without formally opening the abdomen, but in general an incision made directly into the latter cavity is necessary for complete exposure of the parts.

The upper end of the intestine and next the lower end are defined and freed from adhesion. The bowel is then clamped, above and below, beyond the site of operation by one of the many devices invented for this purpose. Maunsell uses the simple means of a flat sponge and a safety-pin passed through sponge and mesentery. Others prefer the fingers of an assistant, but these may become fatigued, and are apt to make unequal pressure. The small elastic band of Neuber, passed through the mesentery near the gut, and tied or fastened with catch forceps at the convex border, has the approval of Senn. In some of his experiments Senn found this method less injurious to the tissues of the bowel than metal clamps, and more secure in preventing extravasation. Hagemann used silk threads applied in the same manner. Makins' forceps, whilst exerting a uniform and adequate compression, take up very little space, and do not perforate the mesentery.

The two portions of bowel are now brought to the surface, the abdomen is temporarily closed with sponges, and the provisional plug is withdrawn. The amount of gut to be sacrificed is next determined. This decision rests partly on the extent of the adhesions and partly on the difference in calibre of the two portions. The upper bowel is usually of normal dimensions, and by cutting through the lower bowel at some distance from the false anus, a tube of nearly equal dimensions can be obtained. When the lower intestine is contracted, it may be dilated to some extent with the finger. Baracz invaginated the cæcum through the ileo-cæcal valve, and thus enlarged the lower end of the ileum, which was the part implicated. A favourite plan is to cut the

upper bowel transversely and the lower obliquely to the longitudinal axis, taking more from the convex than from the mesenteric border (Wehr). Sometimes the sutures in the larger segment have been placed a little wider apart than in the lower (Schinzinger), but this practice is very objectionable. Other methods, such as making a fold in the wall of the larger gut, are more likely to be needed in cases of primary resection.

The bowel is next liberated either by cutting a wedge-shaped piece out of the mesentery, or preferably by making the division parallel and near to the intestine. The cut in the mesentery must not extend beyond that in the intestine, as a part of the tube thus deprived is liable to slough.*

The bleeding from the cut surfaces is somewhat free, and many vessels may require ligature. For this reason, probably, some divide the mesentery with the thermo-cautery. It is not permissible to use pressure to the freshened ends of the intestine which it is desired to unite by first intention. The wound in the mesentery is now closed with a continuous suture,† the parts well washed, and the restoration of the bowel proceeded with.

The needles most suitable for the purpose are ordinary fine sewing needles, as recommended by Madelung, and for the suture a fine Chinese silk twist. The great danger in this operation is the premature separation of the stitches, and if an extremely fine silk is used it is likely to cut through the tender tissues of the bowel sooner than is desired, wherefore Hagemann advises an ordinary sewing needle and silk of corresponding thickness.[73]

Of all the various modes of uniting the intestine, that by two rows of sutures after Czerny's plan has enjoyed the greatest popularity. The mucous membrane is first sewn together with a continuous or interrupted suture. The object of closing the mucous canal is to keep its contents from contact with the serous layers till these have healed. A considerable saving of time and yet very perfect apposition can be obtained by using the continuous suture. But even on such a matter the highest authorities differ, for Madelung insists upon the interrupted suture, whilst Nussbaum as strenuously advises a continuous one. The stitching of the mucous membrane is most conveniently made by passing the needle from the interior of the gut, whilst sewing the mesenterial half of the tube, and from the submucous side, whilst sewing the opposite

* Zesas and Reichel have shown that a piece of gut, deprived of mesentery, is less likely to suffer gangrene if the cut is made not close to but some millimetres from the wall of the bowel.

† Professor Kocher, after tying all bleeding vessels in the mesentery, abandons it without passing any sutures. (Cent. f. Chir., 1886, p. 691.)

or distal half (Baracz). Next, proceeding to the union of the muscular and serous coats by Lembert's suture, the mesenterial edge must be first attended to. It is here that failure in the stitching has most often occurred, as it is so difficult to bring the serous surfaces into just coaptation at this spot. Madelung first sews together the two edges of mesentery close down to the bowel, so as to leave the least possible portion uncovered by serous membrane. In passing the Lembert sutures, which should begin at the mesenteric attachment, care should be taken that the muscular coat, which is liable to retract, is included in each stitch. To facilitate the introduction of the Lembert sutures, and to insure coaptation of corresponding parts in each segment, Mr. Greig Smith recommends the insertion of "four quilt sutures on the opposite sides of the divided gut, in the exact line in which the Lembert sutures are to be placed; the two on each side are gathered together in the blades of catch forceps, and gentle and steady traction made on them by an assistant. This raises a well-defined fold along the edge of the bowel; into this fold the sutures are inserted." [74]

Every stitch must be perfect,* and pass through the serous and muscular layers, and as Hagemann observes, the stitches must not be tied too tightly; they must not be tied too loosely; and they must not tear the tissues as they are passed.

The effect of Enterorhaphy is to cause a circular projection of the mucous membrane which encroaches on the lumen of the bowel along the line of suture. Hence there may be a greater or less degree of obstruction immediately following the operation, and to this temporary stenosis, a permanent stricture may succeed. Kummer quotes three cases from Götz's Table, fatal from obstruction in consequence of swelling at the suture line. In an experiment on a dog with the Czerny-Lembert suture, Kummer found eight days after the operation considerable stenosis with dilatation of the gut above. If this occurs in man, the partial obstruction is likely to cause perforation, as Kummer shows. To obviate this tendency, Nicaise, Madelung, MacCormac, and others cut each end of the bowel obliquely, taking more from the convex than from the mesenteric border of the intestine. The gut always shortens after division, and the mucous membrane prolapses. Röser suggested that the redundant mucous membrane should be cut away, and though this was done by Rydygier in an experiment on a dog, yet the Czerny-Lembert suture made an internal projection of the united edges.

* To test the efficiency of the stitching, Hagemann and others leave out a suture or two at the convexity of the loop, and introduce a fine tube, through which an antiseptic solution can be injected into the bowel under some pressure, and a leak detected. If all is sound, this small opening is closed, and the further steps proceeded with.

Kummer has described a method, which he has practised successfully in experiments on animals, that places the suture swelling outside and not inside the lumen of the tube.* After transverse division of the gut, the mucous and submucous coats are seized with forceps, and easily separated from the muscular tunic for some distance. The musculo-serous layer is at first turned back, like a cuff, and the cylinder of mucous and submucous tissue is then resected for a length of 1½ centimetres. The edges of mucous membrane are united with a continuous suture, and then the musculo-serous layer is unfolded, its edges turned in, and its folds united with Lembert sutures. Kummer claims for this method that it produces no narrowing of the intestine.[75]

After the Suturing of the Bowel is concluded, the mesentery, which now forms a fold, should be sewn together along its free margin. This is necessary, as Mr. Treves so well explains, in order to close the pouch which is gaping, to prevent "kinking" of the bowel, and to give the fullest support at the line of suture.[76] The bowel is next carefully washed, and, after all sponges are removed, returned to the abdomen. If the bowel has been drawn down into the remains of the sac, it will probably be necessary to enlarge the hernial orifice to admit of its return in its now bulky condition. The wound in the parietes is then closed, and the operation concluded.

In such cases the after treatment consists in withholding food by the mouth as long as possible during the first week. Nutrient enemata every four hours, injections of warm water into the rectum to relieve thirst, and the administration of opium to keep the intestine at rest and to relieve the discomfort and the pangs of hunger, should be continued for three or four days. Fluid foods may be gradually given in small quantities by the mouth on the fourth or fifth day. According to Tchertmeisky Barischewsky, the mucous membrane does not acquire a complete covering of epithelium till the fourteenth day,[77] but pulpy foods have been given with safety much earlier than this.

Union by Anastomosis. In certain cases, when the fistula is high up the intestine, and the patient is feeble, or when the adhesions are very extensive, and the surgeon is unwilling to excise a long tract of intestine, he may prefer to restore the channel of the bowel by Senn's method of anastomosis; by perforated, decalcified, bone plates. These have a central oval opening three-quarters of an inch long by half an inch wide, and are provided with four threads passing through holes, pierced in the plate close to the edge of the aperture. One of these holes is on each side and one at each end.

In Senn's operation, applied to the purpose in question, the steps will

* A method very similar to this is said to have been previously proposed by Morisani of Naples.

be the same as those already described for secondary resection up to the point when the union of the bowel has to be undertaken. The two portions of bowel about to be approximated are emptied of their contents by gently passing them between the fingers, and both are then clamped in two places. An incision is made into each of these isolated portions an inch long, which divides the convex surface of the bowel in the longitudinal direction, and into each opening a bone plate is inserted and secured. After the bone plate enters the bowel, the needles of the two lateral threads are passed through the whole thickness of the bowel close to the cut edge, the needles are removed, and the end threads are brought out at each angle of the wound. The openings are then carefully fitted to one another, and the corresponding threads tied. Around the plates some Lembert sutures are passed, joining the two portions of bowel, to keep the parts steady. The operation is then concluded. This proceeding may be done as above described, or the portions of condemned bowel below the anastomosis may be excised. In that case the divided ends of intestine are inverted and carefully closed with Lembert sutures.

Sachs has invented a modification of Senn's method by which he dispenses with the threads and approximates the two portions of intestine by means of plates which fasten after the manner of a sleeve stud. The plates, when fixed in position, can thus be made to leave a space between them sufficient to insure the contiguous walls of the intestine from undue pressure, and, as no sutures are used, there is no danger of infection of the peritoneal cavity by capillary communication.[78]

The operation of anastomosis is so simple and so rapidly performed that no hesitation can be felt in employing it, if we are assured that the aperture of communication will remain permanently open. This can be provided for, according to Mr. Bowreman Jessett, by making the opening in the bowel $1\frac{1}{4}$ inches in length, and by stitching the mucous and serous membranes of each opening with a continuous catgut suture.[79] Mr. F. T. Paul, when introducing a very ingenious modification of Senn's gastro-enterostomy, showed, by reference to at least six cases of that operation, that though the immediate result is generally satisfactory, the opening after a time tends gradually to close, and symptoms of obstruction are developed.[80]

Union by Invagination.—There is yet another mode of restoring the continuity of the intestine which has found many eminent advocates. It is the method of invagination in which the upper end of the intestine is introduced for a short distance into the lower, and fixed in that position. It has been brought before the profession from time to time without meeting with general approval, and of late years has been strongly recommended by Senn and others. Senn invented a modification of Jobert's method, which he describes as "consisting essentially

in the use of a thin elastic rubber ring for lining the intussusceptum to prevent ectropium of the mucous membrane; to protect the mucous membrane of the bowel against injurious pressure from the suture; to keep the lumen of the bowel patent during the inflammatory stage, and to assist in maintaining coaptation of serous surfaces; and finally, the substitution of catgut for silk as invagination sutures."[81]

The details of the proceeding are as follows:—"The upper end of the bowel which is to become the intussusceptum is lined with a soft pliable rubber ring made of a rubber band, transformed into a ring by fastening the ends together with two catgut sutures. This ring must be the length of the intussusceptum, from one-third to half an inch; the lower margin is stitched by a continuous catgut suture to the lower end of the bowel, which effectually prevents the bulging of the mucous membrane, a condition which is always difficult to overcome in circular suturing. After the ring is fastened in its place, the end of the bowel presents a tapering appearance which materially facilitates the process of invagination. Two well-prepared fine juniper catgut sutures are threaded, each with two needles. The needles are passed from within outwards, transfixing the upper portion of the rubber ring and the entire thickness of the wall of the bowel, and always equidistant from each other; the first suture being passed in such a manner that each needle is brought out a short distance from the mesenteric attachment, and the second suture on the opposite convex side of the bowel. During this time an assistant keeps the opposite end of the bowel compressed to prevent contraction and bulging of the mucous membrane. The needles next are passed through the peritoneal, muscular, and connective tissue coats at corresponding points about one third of an inch from the margins of the opposite end of the bowel, and when all the needles have been passed, an assistant makes equal traction on the four strings, and the operator assists the invagination by turning in the margins of the lower end evenly with a director, and by gently pushing the rubber ring completely into the intussuscipiens. The invagination accurately made, the two catgut sutures are tied only with sufficient firmness to prevent disinvagination should violent peristalsis follow the operation. This is their only function . . . after a few days the rubber ring becomes detached, and by giving way of the catgut sutures is again transformed into a flat band, which readily passes off with the discharges through the bowels."[82] Senn further protects the line of junction by fastening around it an omental flap.

It cannot be denied that there are grave objections to the method of invagination, as Madelung so well demonstrated.[83] Its principal recommendation is the rapidity with which it can be performed, as compared with end to end suturing. Of the several plans by which union by

invagination can be carried out, one of the most promising is that invented by Mr. F. T. Paul in 1891, and successfully practised by him upon the human subject in November of the same year.*

In this operation a "decalcified bone tube is prepared, to which is attached a needle and a strong silk thread, called the traction thread.† . . . The piece of bowel having been excised, the tube is sewn into the upper end, and the traction thread passed through the wall of the lower segment about three inches down. Next the two cut ends of bowel are quickly attached to each other with a continuous suture. An assistant now draws firmly on the traction thread, whilst the operator produces a short invagination which is retained in position by three or four Lembert sutures. Finally the traction thread is drawn tight and cut off short, its ends dropping into the bowel. . . . When invaginating, an error must be guarded against. The invagination is most easily produced by allowing it to commence about half an inch or so below the tube. This means that the cut will be barely covered by it, whilst the lumen of the bowel will be considerably blocked, and the operation consequently most imperfectly performed. It must be made to commence immediately below the tube by drawing the very first part of the lower segment upwards with the tips of the fingers, and care must be exercised to observe that the mesenteric side of the bowel is as thoroughly covered by the invagination as the other side. . . . It is claimed for this operation that the closure is absolutely secure so long as the bone tube remains intact, or until sloughing has had time to occur; a free passage is at once established; the opening does not subsequently diminish or close; the operation has had the appearance up to the present of being, *per se*, free from danger."[84] Mr. Paul advises that the patient should be fed freely with fluid nourishment from the first, for sound and rapid healing cannot be expected in a starving body.

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CHAPTER XL.

ON THE TREATMENT AFTER HERNIOTOMY AND THE PERSISTENCE OF SYMPTOMS AFTER REDUCTION.

The Treatment of the Patient after Herniotomy concerns especially his constitutional state, and it will not be necessary to give directions about the care of the wound, which differs in no material respect from that of other wounds of the abdominal wall. After cicatrisation is complete, a truss should be applied, and this will probably be the most prudent course, even though a curative operation has been done in addition to the herniotomy.

In cases of no great severity the after-treatment consists in keeping

the patient warm in bed, in feeding him with fluid foods, which at first (during twenty-four hours) must be given sparingly, and in abstaining from the use of drugs till they are called for by some positive indication.

Administration of Purgatives. – Up to the middle of this century it was the practice to administer, soon after the operation, purgatives by enema or by the mouth, because it was supposed that the patient would not feel complete relief until the bowels had acted. This pernicious routine was upheld by the teaching of Travers and Lawrence, and appears to have been general both in this country and France in spite of occasional protest. The practice was condemned by Dupuytren, Guthrie, South, Cock, Arnott, and others. Hancock made a statistical comparison of cases treated after operation with and without purgatives, and found the difference in the mortality to be 36 per cent. against the purgatives.* The custom seems to have passed out of use after 1865, and now has no respectable advocate. If the strangulation has been short, even though severe, the chief danger arises from the effect on the nervous system of the irritation of the nerves of the part, and this irritation ceases when the bowel is liberated. The danger from obstruction in such cases is insignificant, and the bowels can safely be left at rest. When strangulation has lasted for some days, the danger from obstruction is more likely to be pressing. The intestine does not act either because the part above the strangled loop is paralysed or because there is peritonitis, which has the same effect, and in both these cases any attempt to unload the bowels by medicine is particularly to be avoided. An enema may do no harm, but it hardly reaches far enough to be of much service. Of all the unfavourable symptoms which may follow herniotomy, constipation is the least important, as was long since demonstrated by Mr. Bryant.[2] The bowels gradually recover their muscular power, if time is given them, and after a week or ten days, if they do not respond to a simple enema or a mild purge, there will be no necessity to urge them whilst the patient's state continues good. Mr. Jalland of Horncastle operated upon a woman, æt. 52, for femoral hernia, whose bowels remained constipated, notwithstanding a dose of castor-oil on the fourteenth day, till three weeks after the operation, when they acted spontaneously.[3]

Diarrhœa after Operation.—The purgatives which are sometimes given unadvisedly before the operation, even at the present day, may cause several loose stools after reduction. If not very copious and very numerous, they are not of serious importance, nor is the liquid stool which passes sometimes just after the bowel is returned, or soon after

* Hancock collected 80 cases which were purged after operation, and of these 38 died; whilst of 69 cases treated without purgatives, 8 died. I place very little reliance upon these figures.[1]

the operation, a symptom of any consequence. But it is far otherwise with the diarrhœa that sets in occasionally during the first twenty-four or forty-eight hours, and increases so rapidly the exhaustion of the patient. It probably depends upon enteritis,* as was suggested by Lavater, who, with others, has insisted upon the gravity of this complication. A copious action of the bowels in children from "three to six or eight hours after the operation" has been regarded by Mr. Howard Marsh as of no great moment.[4] The danger of the diarrhœa both in the child and in the adult depends upon its persistence. Among 15 cases in Table XXXII. in which this symptom was noted, the 7 who lived had few stools, and the 8 who died had many. The treatment chiefly relied upon under these circumstances is opium in small doses, frequently repeated, and the starch and opium enema. As the tendency is toward collapse, brandy should be added to the diet, which cannot be much restricted, except that it may be given in small quantities at a time and peptonised.

The restlessness which is often a prominent symptom before operation, sometimes continues after it, and must be allayed by narcotics. The pain ceases after reduction, and, if it persists or increases, usually signifies the advent of some complication.

When Prostration is present, and even when it is well marked, it may rapidly and completely pass off in some cases after operation. But in very many no such improvement is observed after the bowel is released, and the patient gradually dies in collapse. He may continue in this depressed condition so long as four days without rallying.[5] Very little can be done to restore the patient when prostration is once established. External warmth, brandy, and easily digested fluid foods are the principal but very inadequate means of treatment. A temporary reaction can often be obtained by subcutaneous injections of strychnia or by injections of saline solution into a vein. The pulse can again be felt at the wrist, the lividity becomes less, the hiccough ceases, and the general condition improves. But the amendment is not lasting, and in a few hours the symptoms of depression return in all their intensity.

Hiccough is not a sign which indicates with any certainty the event of the case. It is often present in those about to die, but in not a few who survive, this symptom persists for a time, which may extend even to three days.

Vomiting is the symptom which most commonly persists after reduction, and may be due to a variety of causes. When the hernia has been returned by taxis, vomiting may recur though the intestine is altogether free. I was called upon to put back a strangulated femoral hernia in an elderly man, and succeeded in reducing all but a lax piece of tissue

* The loose motions soon after operation are sometimes mixed with blood, which may either be the result of taxis, or may be due to the enteritis.

which was probably adherent omentum. Three hours later the patient was once copiously sick. As the man had been much subject to vomiting, independently of his rupture, I did not operate, but under such circumstances with a hernia not completely reduced one would be justified in operating, and should certainly do so, if the sickness recurred more than once. Before the days of chloroform, sickness occasionally continued after operation in cases which terminated favourably. Goyrand mentions an instance of vomiting on the first and second days though the bowels had acted a little.[6] The sickness caused by the anæsthetic is sometimes a source of difficulty, if it lasts more than a few hours. It is frothy and bilious without fæcal odour. In cases which otherwise do well, vomiting, if it recurs, comes on, as a rule, within the first twenty four hours, and then ceases, but occasionally it is repeated during three days, and rarely during six days after the operation. A patient sometimes has one fæcal vomit, and later bilious matters are brought up. After successful primary resection of the intestine the patient has been known to have one or two stercoraceous vomitings.[7] Mr. F. T. Paul found much difficulty in allaying this sickness in the successful case of Enterectomy referred to in the last chapter. The vomiting which is transitory, probably depends in most cases on paralysis of the intestine above the strangled loop, and ceases when the bowel recovers its muscular power. But the diagnosis is very difficult when the loop that has been strangulated, does not soon resume its function, and remains contracted whilst the bowel above is overfilled. Mr. Treves quotes two cases of Mr. Pitts' and two of Henrot's in which laparotomy was performed under the supposition that this obstruction was due to a mechanical cause.[8] If the surgeon has taken due pains to assure himself that the bowel has been quite set free and returned fairly into the abdominal cavity, he will know that the vomiting is not owing to any imperfection in the operation.

A common cause of persistent vomiting after operation is **peritonitis.** The symptoms of this complication are usually sufficiently manifest, not only by the vomiting, but by the pain, tenderness, and distension of the abdomen.

Enteritis, as a sequel to herniotomy, is generally attended with loose stools that may contain blood, and by vomiting which may be stercoraceous, and when the first of these symptoms is present there is little likelihood of error. Moreover, according to Mr. Treves, the abdomen is sunken, the pain paroxysmal, and there is comparatively little tenderness. A woman who died in St. Mary's Hospital with acute membranous enteritis of 4 feet of the ileum, said she had no pain.[9] But sometimes there is no stool in these cases, and it may be supposed that the bowel has not been released or has become obstructed. The passage of flatus serves, according to Perret,[10] to distinguish the vomiting due to

enteritis from that of persistent strangulation. Peritonitis without other complications and enteritis are both best treated with opium.

The distension of the abdomen and retention within the bowel of septic alimentary matters are grave dangers in peritonitis, and it is much to be desired that these symptoms could be safely combated by the administration of saline purges. Mr. Greig Smith, Professor Senn, and others are in favour of using purges for peritonitis occurring after abdominal operations, and one may be sorely tempted to apply the same remedy in the peritonitis after herniotomy. The chief objection to so doing lies in the possibility of lesion at the site of stricture, which in many cases is the starting-point of the peritonitis. If under these circumstances the intestinal current is hastened, perforation is likely to ensue, when the surgeon will find to his dismay that he has emptied the intestine into the abdominal cavity.

A form of **Septicæmic Peritonitis** has been described by a French writer which has the following characteristics. The patient does well after the operation for two or more days. There is then a slight rise of temperature, the patient complains of nausea, and the tongue becomes dry. The symptoms now rapidly increase in severity. In a few hours the state of depression is well marked, the breathing is oppressed, and the temperature reaches 104°, or still higher. Yet the belly is neither painful nor distended, and the stools are not suppressed. The patient sinks lower and lower, and dies in collapse. This condition was successfully diagnosed by Peyrot, who opened and washed out the peritoneal cavity, and the patient recovered.[11]

The occurrence of Perforation is signalised by sudden, intense, abdominal pain, and by vomiting. The symptoms of peritonitis, if not already present, develop rapidly in their most acute form, and soon terminate fatally. When extravasation is prevented by adhesions, the signs are those of a local peritonitis. Perforation, as before mentioned, occurs at various periods, and may be produced spontaneously or from slight mechanical causes. A patient, among those in Table XXXII., had a fit of coughing on the second day after operation, and immediately complained of severe pain in the belly and vomiting. After death, two days later, the bowel was found perforated. The intestine sometimes gives way and extravasation into the peritoneum takes place without any sudden accession of symptoms, but vomiting comes on, as a rule, soon after the event. If the perforation can be diagnosed, the only chance of life for the patient is to open the abdomen at once, secure the leaking bowel, wash out the peritoneal cavity thoroughly with hot water,* and form an artificial anus at the herniotomy wound, or unite immediately the ends of bowel after resecting the damaged part. The result of

* The water should be at a temperature of 108° to 110°.

perforation is not necessarily or generally fatal when the fæcal matters come by the wound. A case is recorded in Froriep's Notizen of a man who surreptitiously drank beer three days after operation, and by reason of his haste coughed after drinking, whereby the bowel was burst and the contents escaped externally.[12]

Gangrene after Reduction. When the bowel which has been reduced after strangulation by taxis or by operation, becomes gangrenous, symptoms arise somewhat resembling those of perforation. The pain is a less prominent symptom, and less sudden in onset, but in both complications the vomiting is at first bilious and afterwards fæcal, and the prostration is extreme.

Fresh Descent of Gut.—In very exceptional cases a piece of bowel descends after the operation and becomes strangulated, so that the symptoms seem to continue, though in reality they are due to a second strangulation.

Incomplete Reduction. After reduction or apparent reduction by taxis or by operation, the symptoms of obstruction may persist because the bowel has not been released from constriction. Most of these cases have been already mentioned in the preceding chapters, but for convenience of reference they will be here grouped together. The hernia may be incompletely reduced either because the surgeon has not noticed that a small part is still external, or because the sac possesses two narrowings, one at the neck and one below, and the bowel has only been reduced through the first of them (see page 92). In the chapter on Interstitial Hernia I have dwelt at length upon the danger of partial reduction, and have indicated the signs by which it is known that the parts are not completely liberated. Cases have been recorded, and some have been described on page 352, in which two herniæ have been present, and the operation has been performed upon the one not strangulated. It is somewhat difficult to understand why the surgeon does not recognise that the bowel which he lays bare, is not in a condition of strangulation. An explanation which may apply to some of them, is suggested by a case of Callisen's, which is quoted by Rougemont. Callisen operated on a bubonocele, and found the bowel acutely inflamed. It was returned without difficulty, but the symptoms continued, and after death it was discovered that there were two sacs (hernia inguino-properitonealis), and that the intestine had been pushed back into the abdominal portion of the hernia.[13] Judging from this case, we may suppose that if there are two distinct herniæ, the one that is strangulated sets up a peritonitis which spreads to the bowel in the second sac, and thus the surgeon is deceived when he exposes the inflamed bowel, and mistakes its condition for the effect of strangulation. In the same manner might be explained the oversight when a non-strangulated hernia is operated upon whilst

the symptoms depend upon an internal strangulation (see page 356). Sometimes the bowel is returned taking with it the agent of strangulation, and of this instances have been given on page 99. Again, the bowel may be returned and accidentally pushed under a band formed by organised adhesion or by omentum attached to the parietes,[14] and thus a second strangulation is begotten in the act of destroying the first.

"**Réduction en Masse.**"—The various accidents, accompanied by persistence of the symptoms, may now be considered which have been described under the name of "réduction en masse."* The parts protruded, with the sac or without it, are pushed out of sight, but they are still in the grasp of the constriction. Hancock collected 84 cases wherein the hernial tumour had been reduced without relief to the symptoms, and 44 were examples of réduction en masse.[15]

Inguinal herniæ are most frequently subject to these displacements, for among 112 instances cited by Bourguet, 101 were oblique and 2 direct inguinal and 9 were femoral herniæ.[16] According to the same authority, the reduction was made by the surgeon 51 times, by the patient 31 times, and 5 times by both patient and surgeon, whilst in two cases the reduction was spontaneous. Bourguet himself met with a case, and quotes another of Dupuytren's in which a scrotal hernia went back *en masse* spontaneously after a bath. Mr. Mayo Robson appears to have met with an instance of the same kind,[17] and in this as well as in Bourguet's case the bowel was disengaged from the constricting agent without operation some time subsequently to the réduction en masse. Nélaton observed in regard to such cases that efforts of taxis have preceded and made way for the spontaneous reduction.

All forms of réduction en masse are rare, but probably the most common variety is that in which the sac with its contents is pushed bodily through the hernial orifice into the abdomen. This may occur in inguinal or femoral hernia. Under these circumstances the neck of the sac may leave the neighbourhood of the internal inguinal or femoral ring, and rise in the abdominal cavity to a distance of an inch and a half (Cruvelhier), of 5 centimetres (Bourguet), or of 3 to 4 inches (Luke) from the parietes. The fundus is then adjacent to the hernial aperture. In other cases the neck of the sac remains near its ordinary position, whilst the fundus is turned into the iliac fossa or towards the pelvis and symphysis pubis. In both these instances the deeper parts of the sac are covered by that part of the parietal peritoneum which it has detached. The two serous layers are thus in contact by their subperitoneal surfaces, and may be in close apposition or separated by a portion

* There is a manifest tendency among authors, more conspicuous in former years than at present, to confuse réduction en masse, imperfect reduction, and properitoneal hernia.

been referred to on pages 320 and 351. Riedel made an exploration after herniotomy on account of the persistence of the symptoms, and found the gut flexed at its mesenterial side like a finger bent to a right angle at all its joints. He resected this portion, and the patient recovered.[28]

Matting of Intestinal Coils.—The coils of intestine from a hernia may become so closely agglutinated that the passage of the contents is interrupted (see page 114), and the obstruction may be so complete that excision of the whole mass or anastomosis of the parts above and below may be necessary.

Remote Effects of Strangulation.—Finally, in very exceptional instances, obstruction of the intestine occurs as a remote consequence of strangulation. A general outline of such cases has been given on pages 114 and 115. The bowel may undergo cicatricial contraction either "from the healing of a loss of substance, or from a well localised contracting peritonitis" (Treves).[29] The symptoms of obstruction appear from a few weeks to a few years after strangulation. The obstruction also arising from adhesion of the bowel and flexion does not always come on immediately, but may be deferred to some weeks or months after operation. The extremity of a loop may become adherent to the parietes, and thus be kept in a flexed position. According to Professor Senn, "if the point of flexion remains free, certain portions of its wall will yield to the pressure of the fluid intestinal contents, and gradually the lumen will be restored. But if the entire circumference of the bowel at the point of flexion has become fixed and immovable by inflammatory adhesions, flexion becomes a direct and serious obstruction."[30] The occlusions of the bowel which occur as a remote consequence of its strangulation in a hernia, belong to the class of intestinal obstructions, the further consideration of which does not come within the compass of this work.

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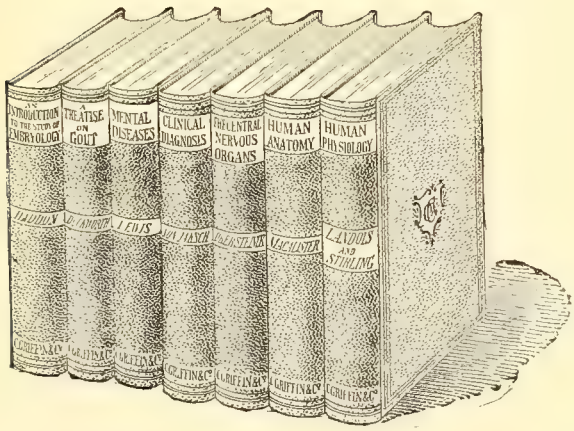

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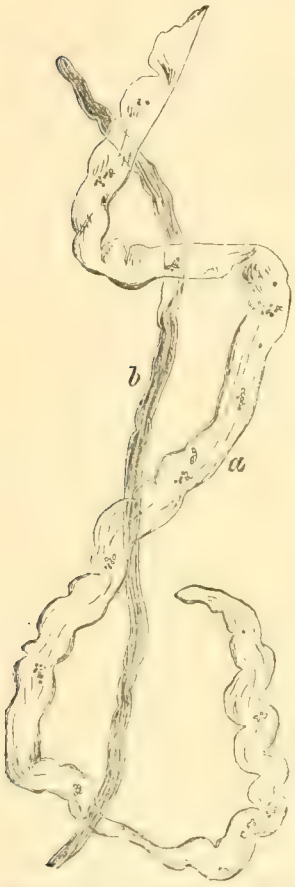

Fig. 86. *a, b.* Cylindroids from the urine in congested kidney.

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Physician to the London Hospital; Consulting Physician, North-Eastern Hospital for Children; Examiner in Medicine, Royal College of Physicians (Conjoint Board for England), and University of Durham; Lecturer on Medical Jurisprudence and Public Health, London Hospital Medical College, &c.

(From Chap. ix.—"The Observed Signs of Neuro-Cardiac Disease.")

FIG. 6.—Case of Grave's disease with well-marked retraction of upper eyelid (Stellway's sign). There was very little projection of the eyeball, though prominence appeared to be extreme. Patient aged twenty-four. (*From a photograph.*)

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Fig. 1.—Human Articular Cartilage, from head of a metatarsal bone (Normal).

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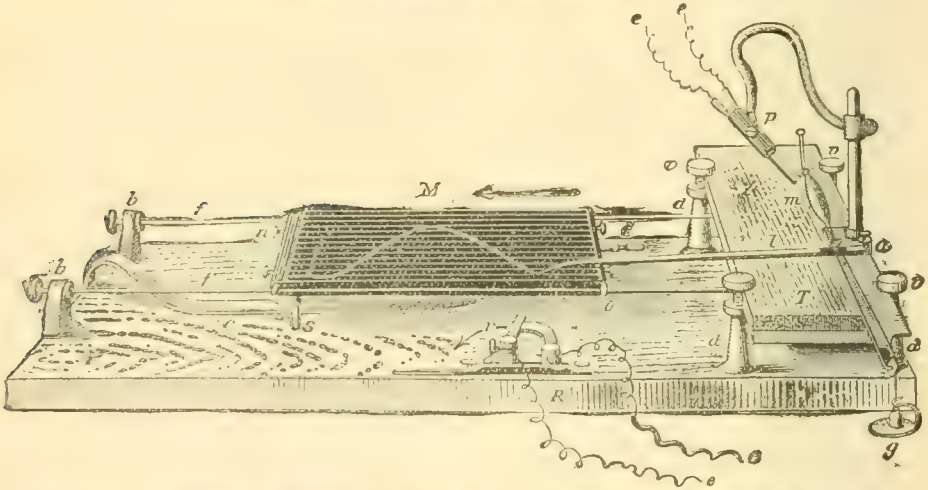

Fig. 118.—Horizontal Myograph of Frédéricq. *M*, Glass plate, moving on the guides *f*, *f*; *l*, Lever; *m*, Muscle; *p*, *e*, *e*, Electrodes; *T*, Cork plate; *a*, Counterpoise to lever; *R*, Key in primary circuit.

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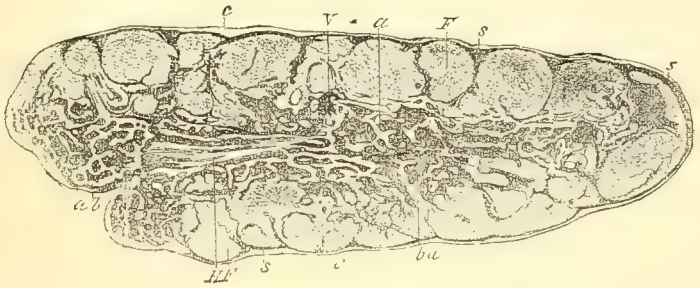

Fig. 200.—L.S., Cervical Ganglion of Dog. *c*, Capsule; *s*, Lymph sinus; *F*, Follicle; *a*, Medullary cord; *b*, Lymph paths of the medulla; *V*, Section of a blood-vessel; *HF*, Fibrous part of the hilum, × 10.

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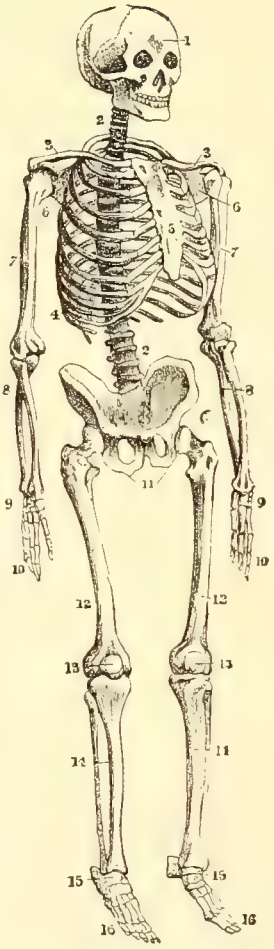

Fig. 5.—Human Skeleton; front view.

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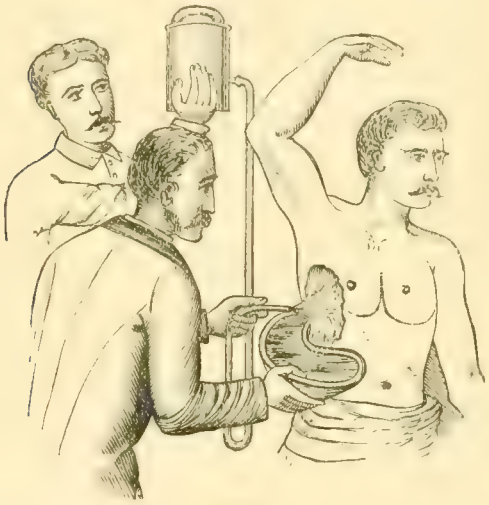

Fig. 72.

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